OBLON ET AL (703) 413-3000
OCKET # 1972634SP SHEET 1 OF 39

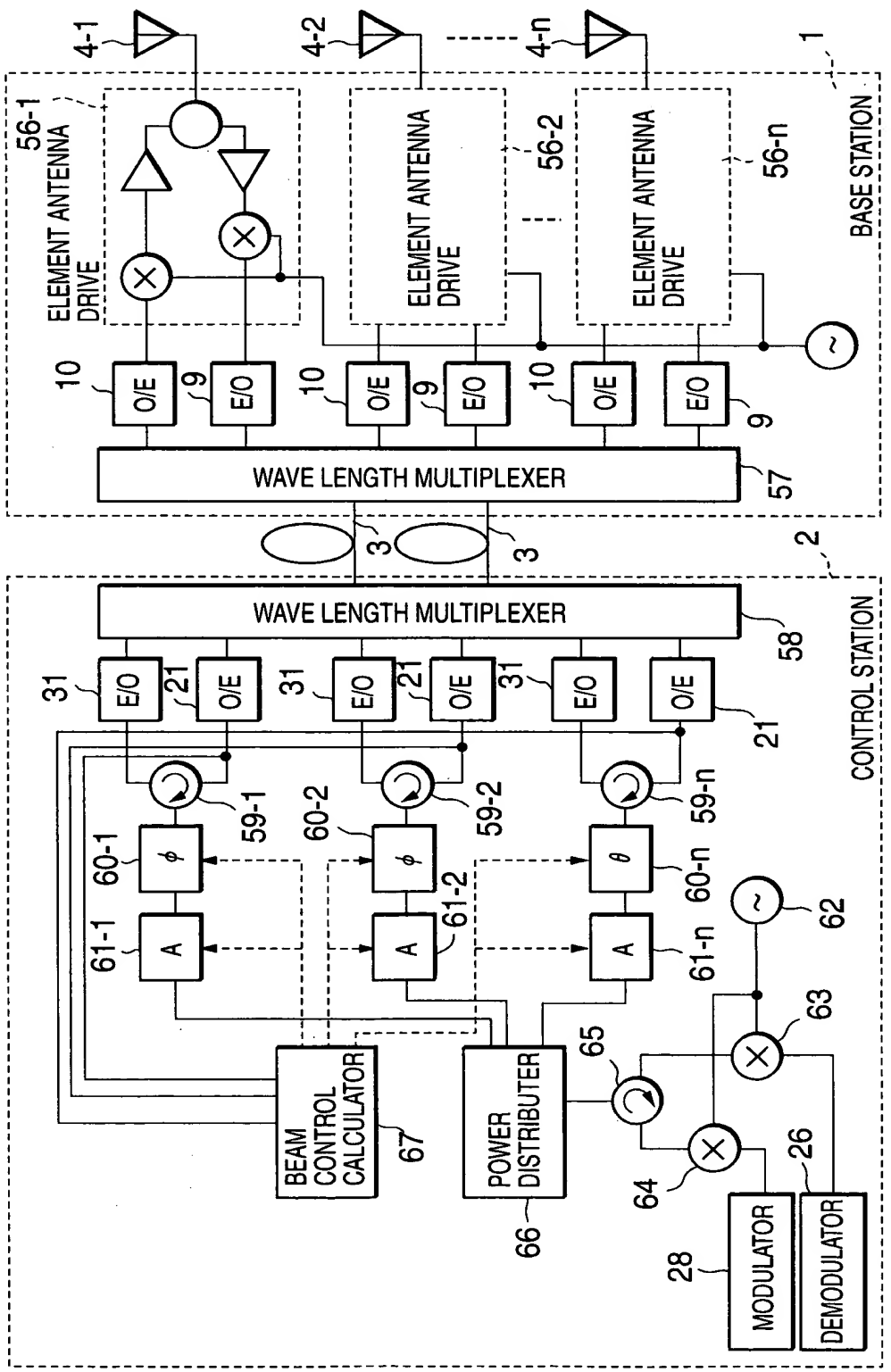


FIG.1

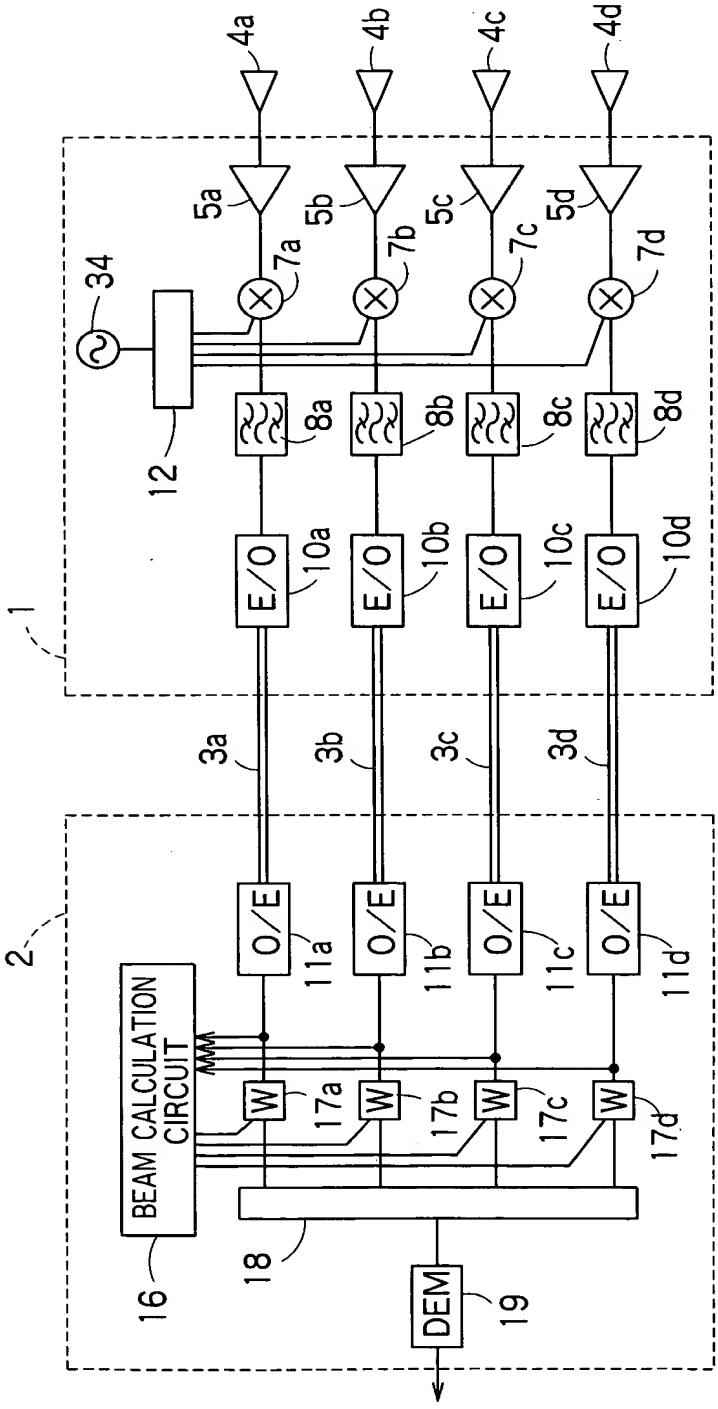

4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
34
12
8a
8b
8c
8d
E/O
10a
10b
10c
10d
1
3a
3b
3c
3d
2
O/E
11a
11b
11c
11d
BEAM CALCULATION CIRCUIT
W
17a
17b
17c
17d
16
18
DEM
19

FIG. 2

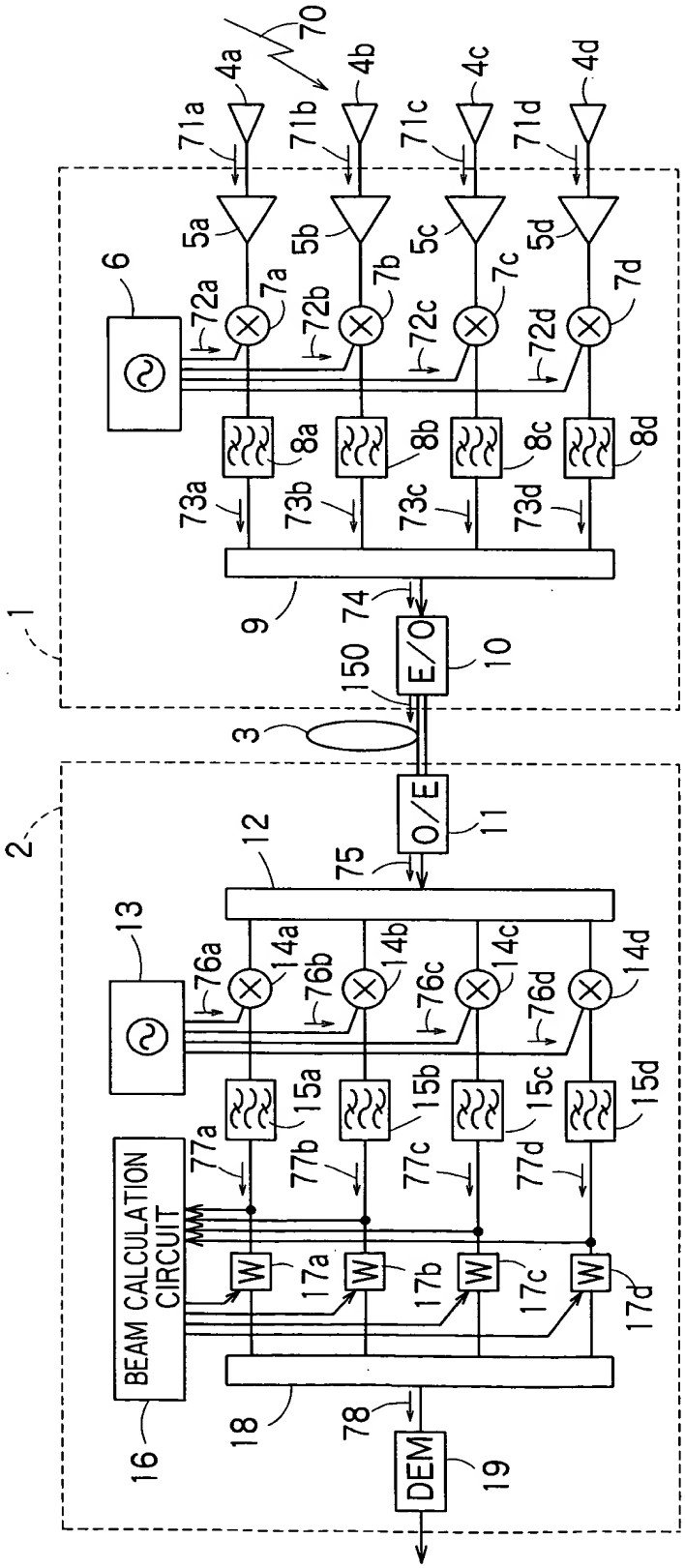

1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
6
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
13
14a
14b
14c
14d
15a
15b
15c
15d
16
17a
17b
17c
17d
18
19
70
71a
71b
71c
71d
72a
72b
72c
72d
73a
73b
73c
73d
74
75
76a
76b
76c
76d
77a
77b
77c
77d
78
150
E/O
O/E
W
BEAM CALCULATION CIRCUIT
DEM

FIG. 3

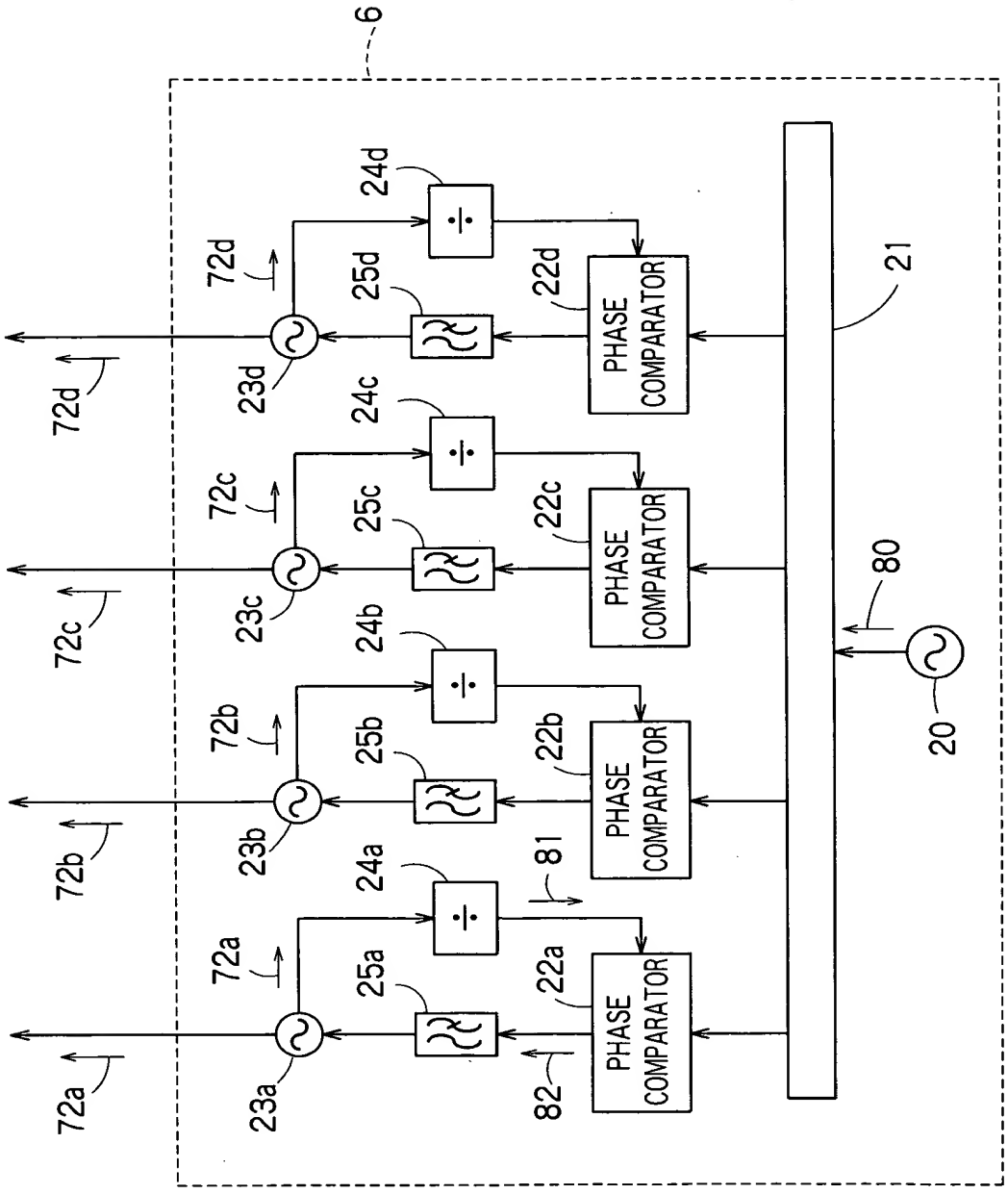

6
21
80
20
81
82
PHASE COMPARATOR
22a
22b
22c
22d
23a
23b
23c
23d
24a
24b
24c
24d
25a
25b
25c
25d
72a
72b
72c
72d

FIG. 4

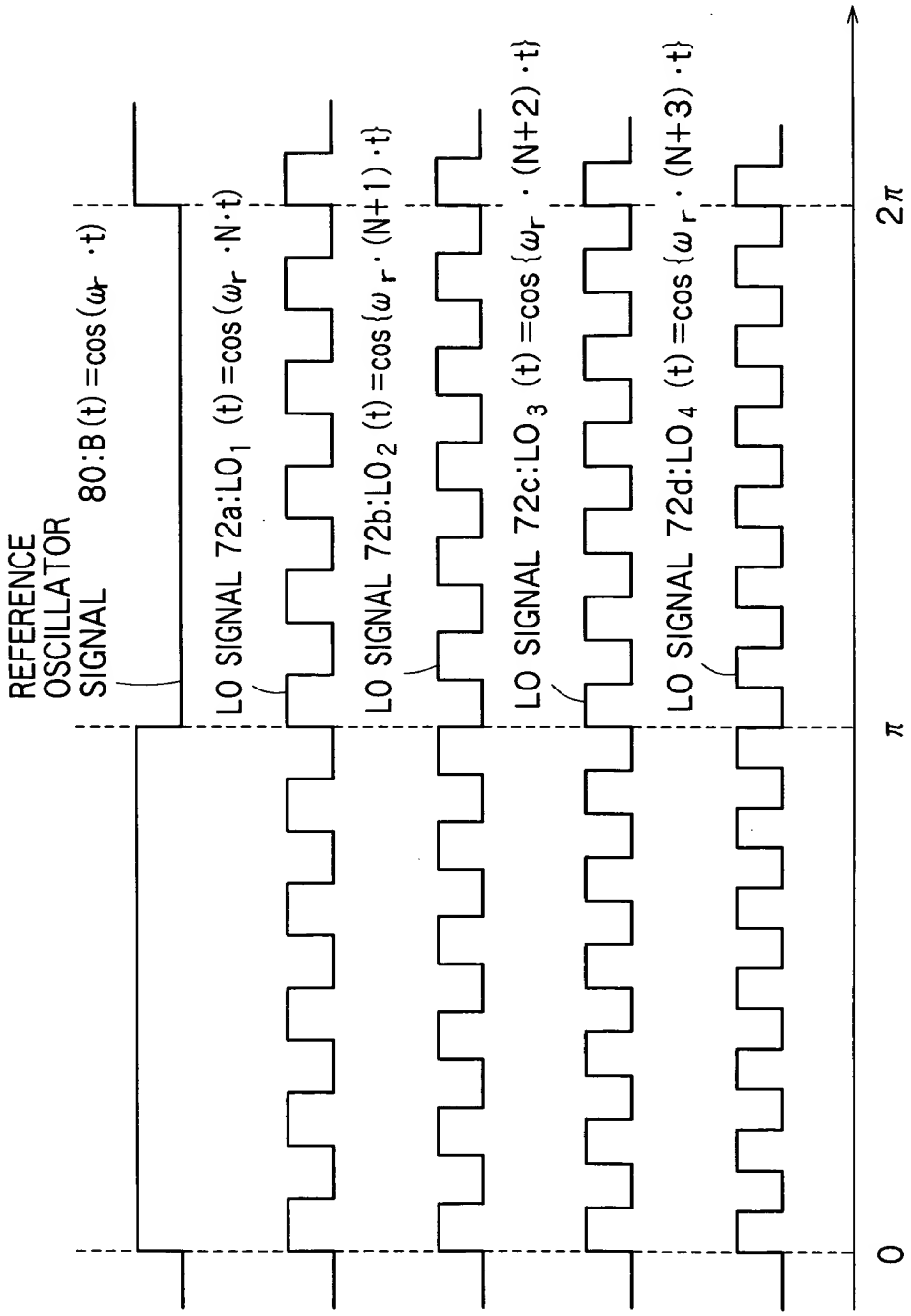
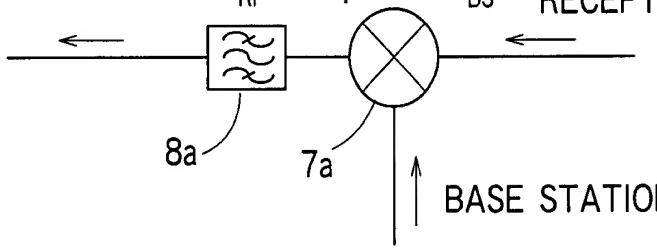

REFERENCE OSCILLATOR SIGNAL
80:B(t) =cos (ωr ·t)
LO SIGNAL 72a:LO1 (t) =cos (ωr ·N·t)
LO SIGNAL 72b:LO2 (t) =cos {ωr · (N+1) ·t}
LO SIGNAL 72c:LO3 (t) =cos {ωr · (N+2) ·t}
LO SIGNAL 72d:LO4 (t) =cos {ωr · (N+3) ·t}
0
π
2π
PHASE φ

FIG. 5

RECEPTION SIGNAL 73a

$R'(t) = (1/2) \cdot \cos[(\omega_{RF} - N\omega_r)t - N\phi_{BS}]$

RECEPTION SIGNAL 71a $R(t) = \cos[\omega_{RF} t]$



BASE STATION LO SIGNAL 72a $LO_1(t) = \cos[N\omega_r t + N\phi_{BS}]$

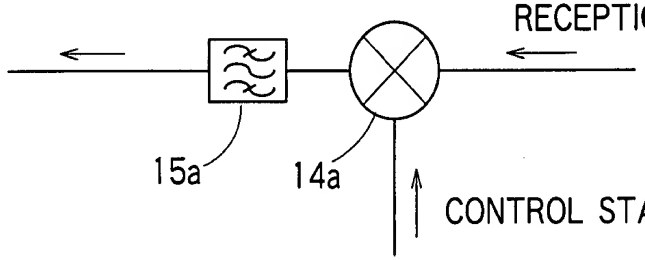
FIG. 6A

RECEPTION SIGNAL 77a

$R''(t) = (1/4) \cdot \cos[\{\omega_{RF} - N\omega_r - (N+3)\omega_r\}t' - N\phi_{BS} - (N+3)\phi_{CS}]$

$= (1/4) \cdot \cos[\omega_{IF} t' - N\phi_{BS} - (N+3)\phi_{CS}]$

RECEPTION SIGNAL 75 $R'(t) = (1/2) \cdot \cos[(\omega_{RF} - N\omega_{LO})t' - N\phi_{BS}]$



CONTROL STATION LO SIGNAL 76a $LO_2(t) = \cos[(N+3)\omega_r t' + (N+3)\phi_{CS}]$

FIG. 6B

OBLON ET AL (703) 413-3000
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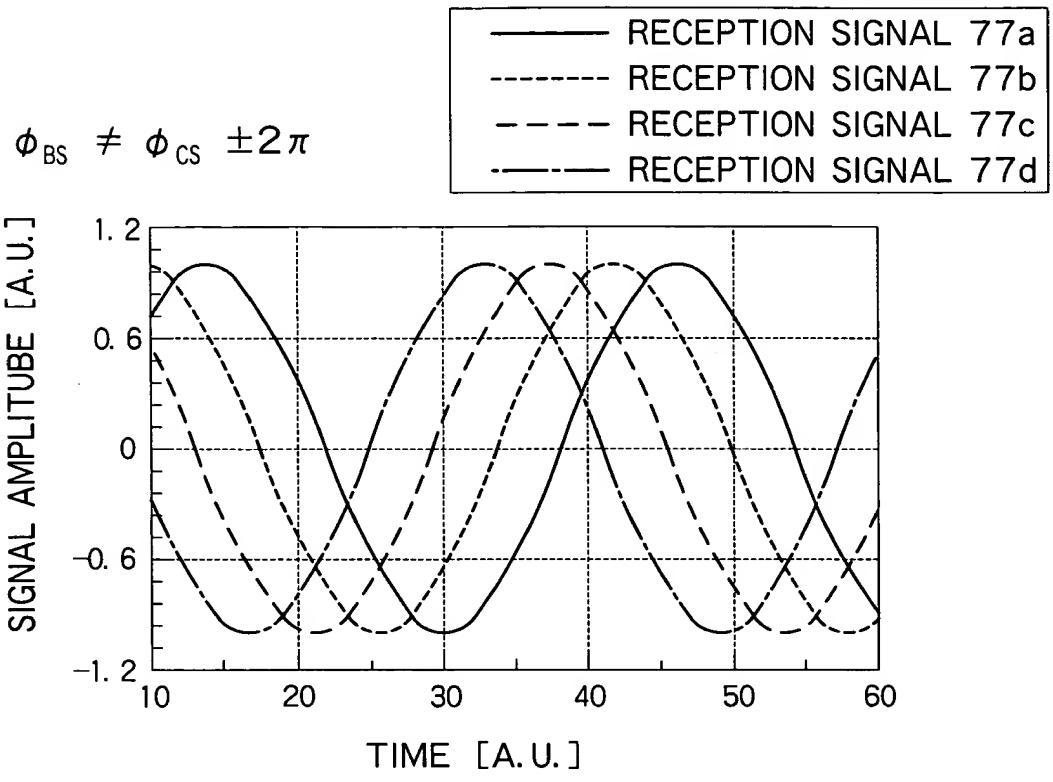

FIG. 7A

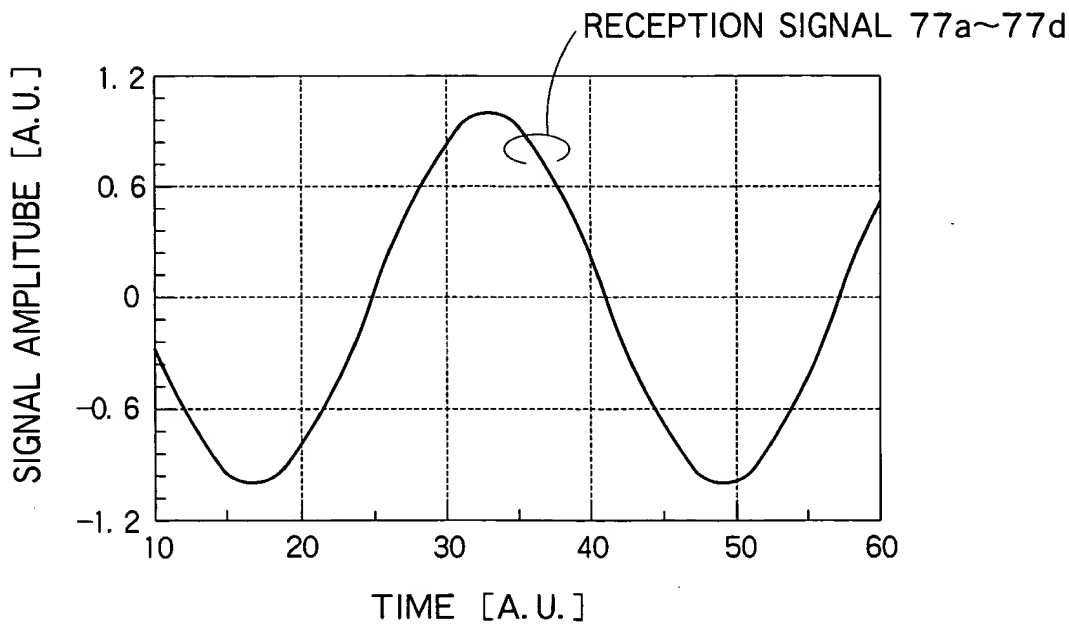

FIG. 7B

0021200 .0950459.5

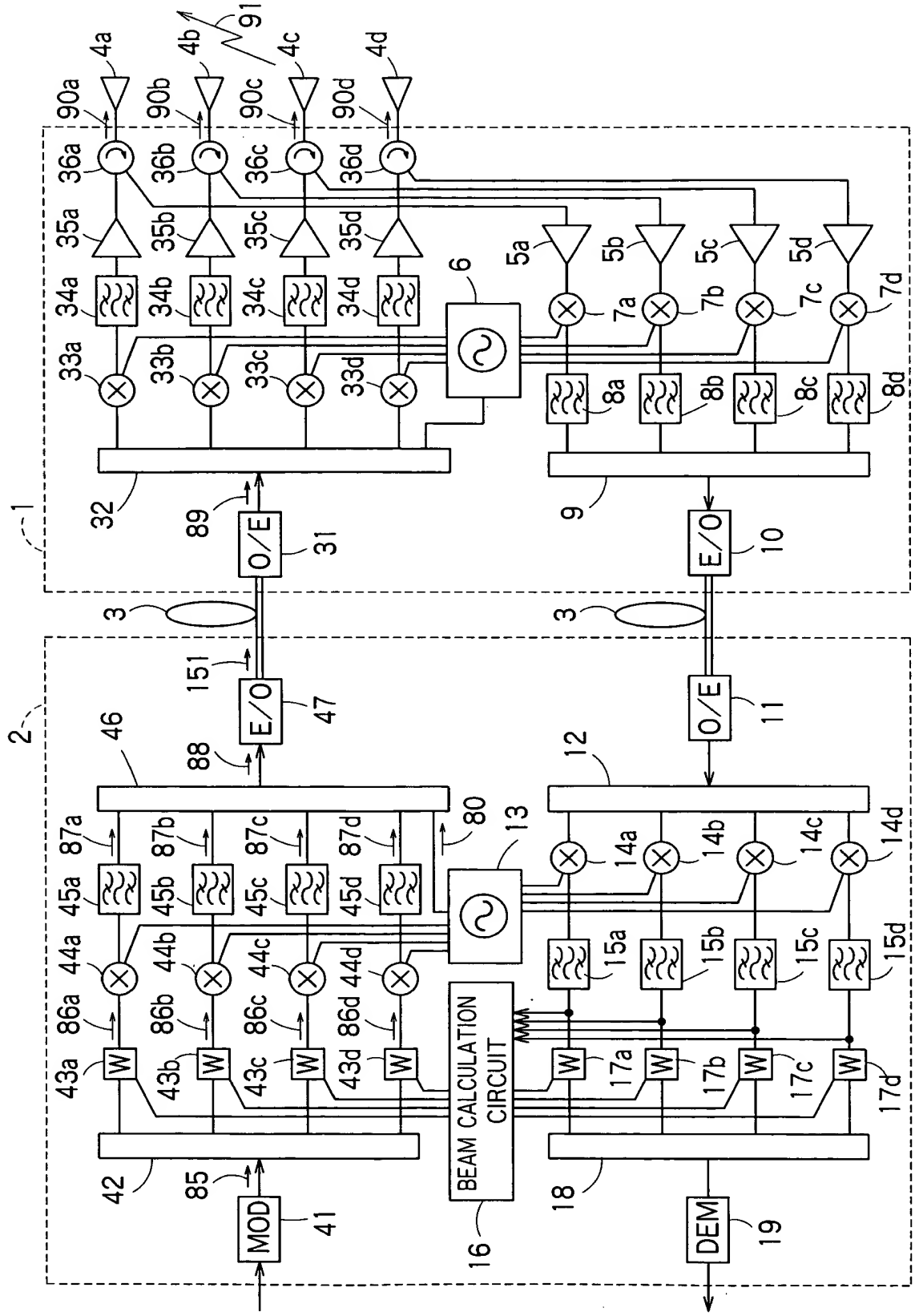

FIG. 8

0027450 "294095.60

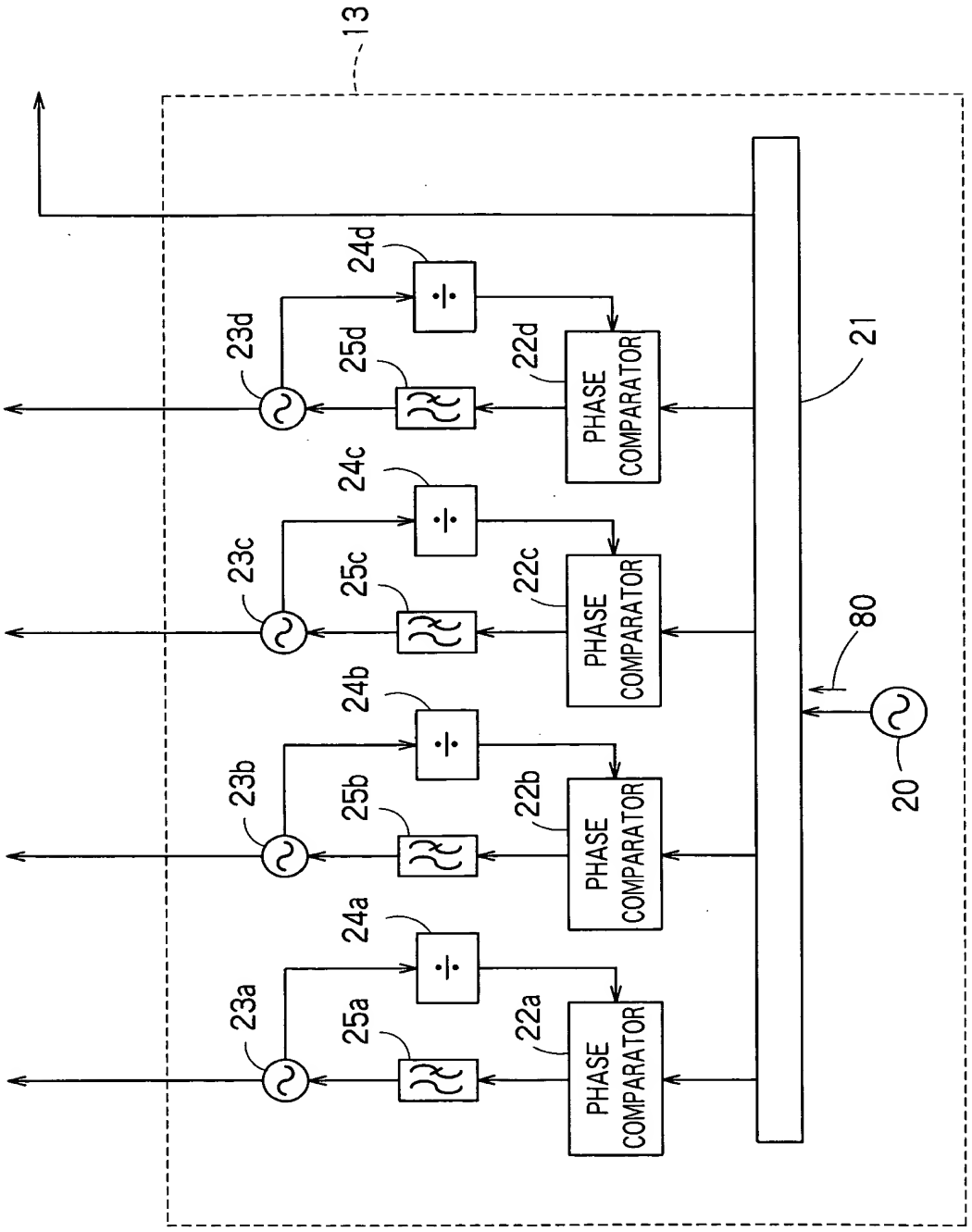

FIG. 9

0027e60 "2644959.0

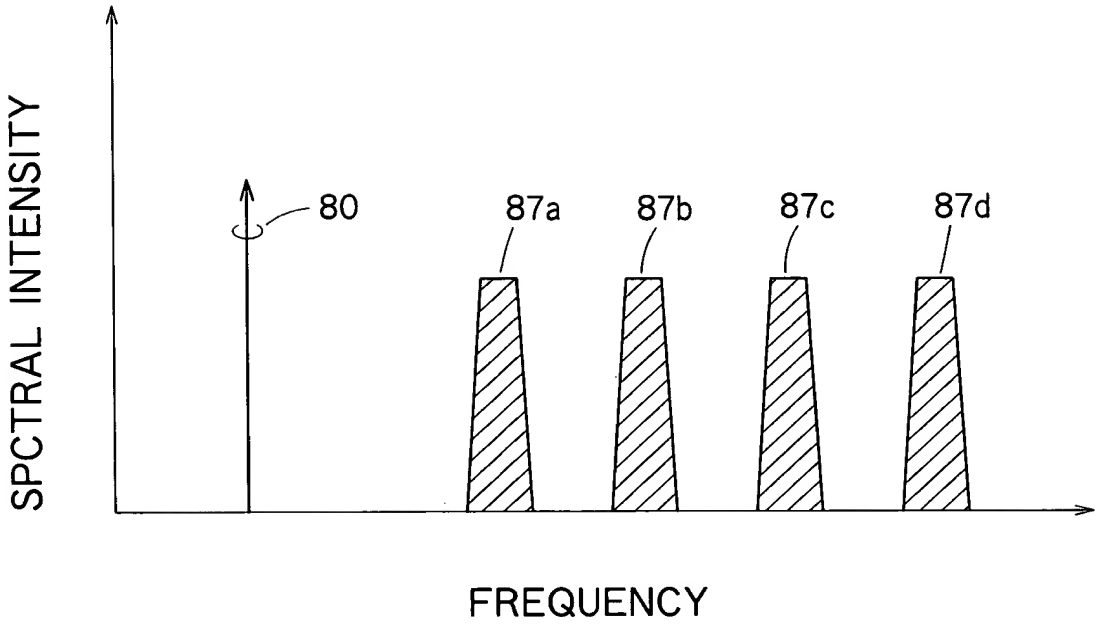

FIG. 10

09604567 - 092200

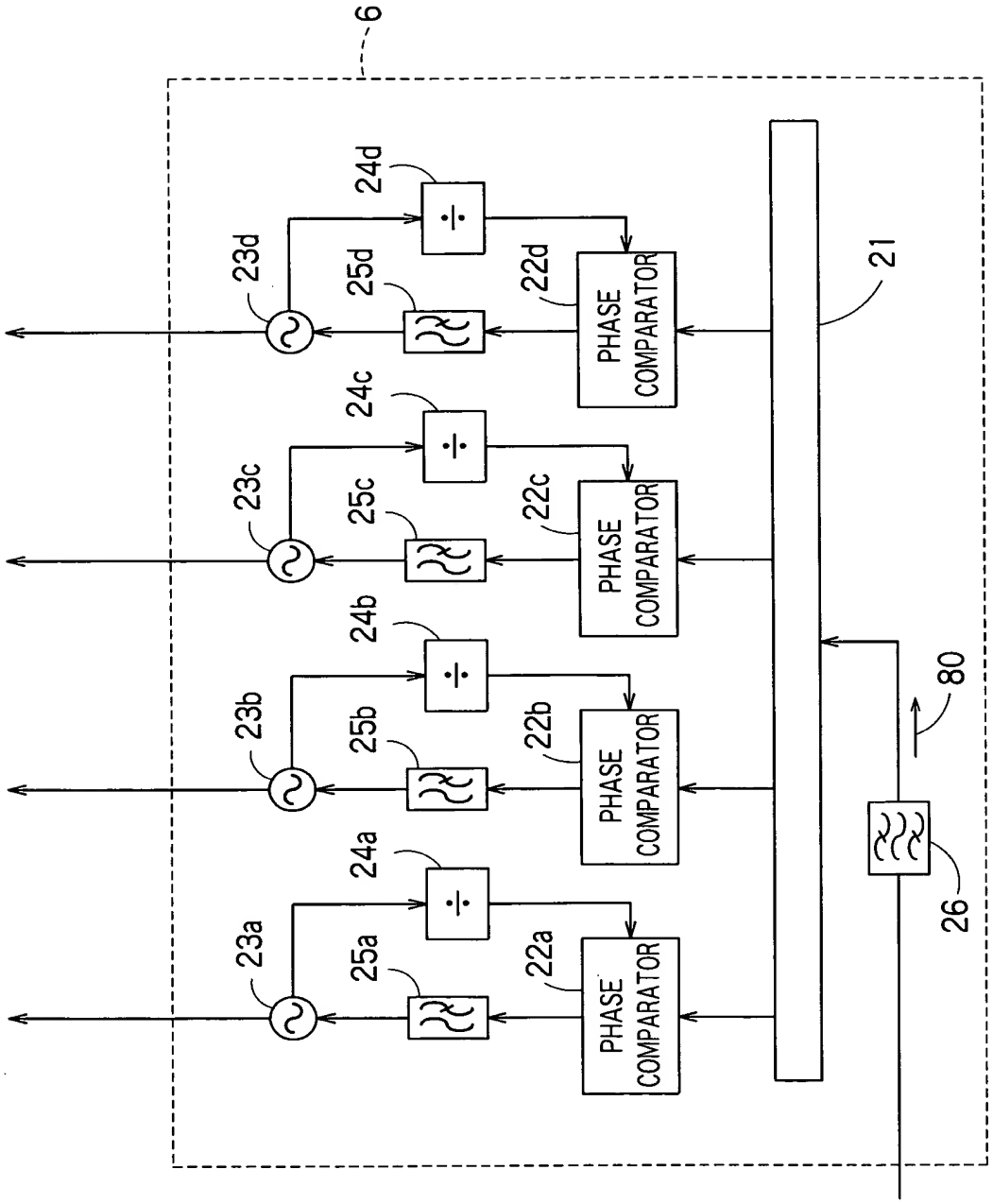
6
21
80
26
23a
23b
23c
23d
24a
24b
24c
24d
25a
25b
25c
25d
22a
22b
22c
22d
PHASE COMPARATOR
PHASE COMPARATOR
PHASE COMPARATOR
PHASE COMPARATOR

FIG. 11

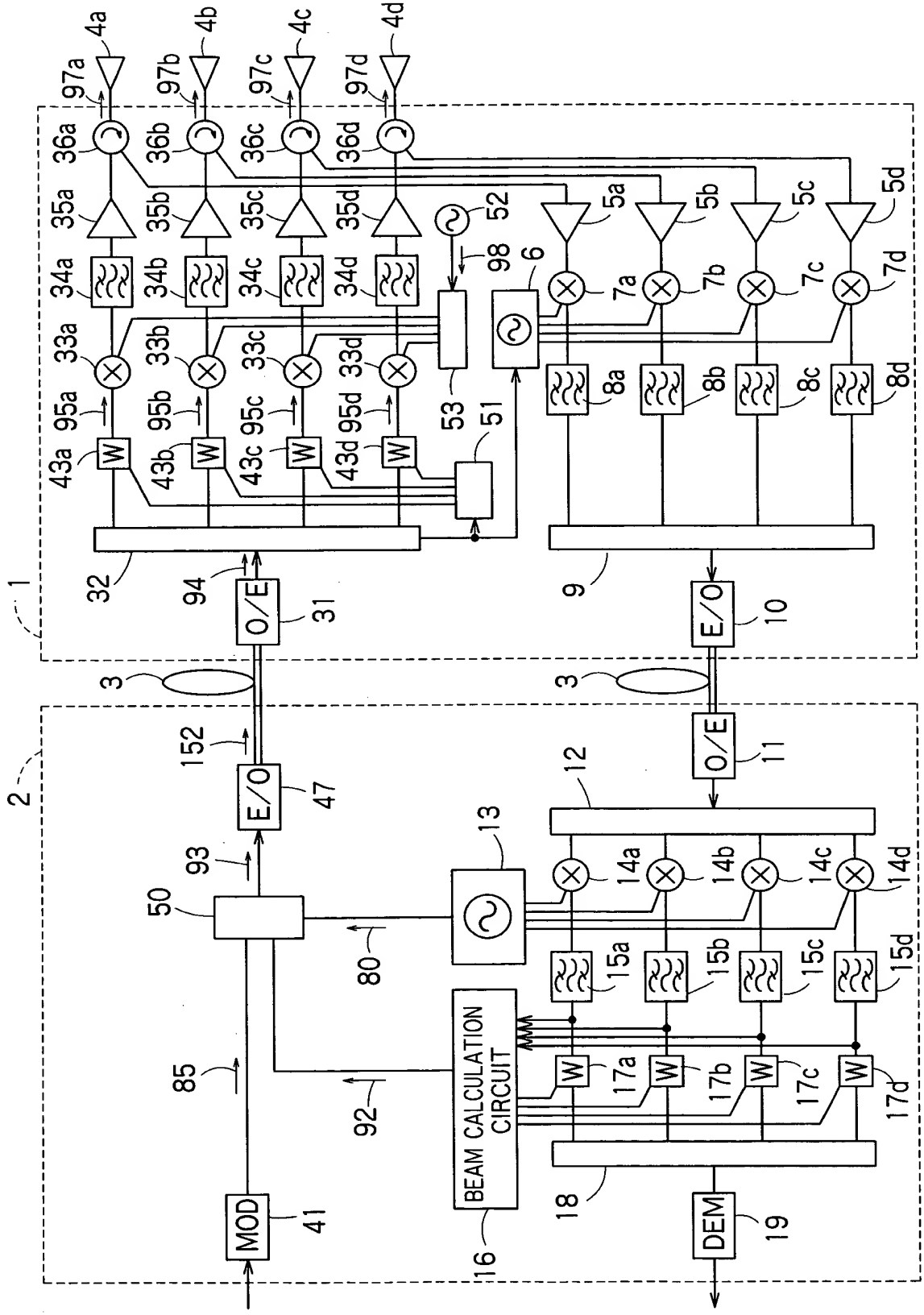
4a
4b
4c
4d
97a
97b
97c
97d
36a
36b
36c
36d
35a
35b
35c
35d
34a
34b
34c
34d
33a
33b
33c
33d
95a
95b
95c
95d
43a
43b
43c
43d
W
32
94
O/E
31
1
3
52
98
6
5a
5b
5c
5d
7a
7b
7c
7d
8a
8b
8c
8d
53
51
9
E/O
10
2
152
E/O
47
93
50
80
13
12
O/E
11
14a
14b
14c
14d
15a
15b
15c
15d
17a
17b
17c
17d
85
92
BEAM CALCULATION CIRCUIT
16
18
MOD
41
DEM
19

FIG. 12

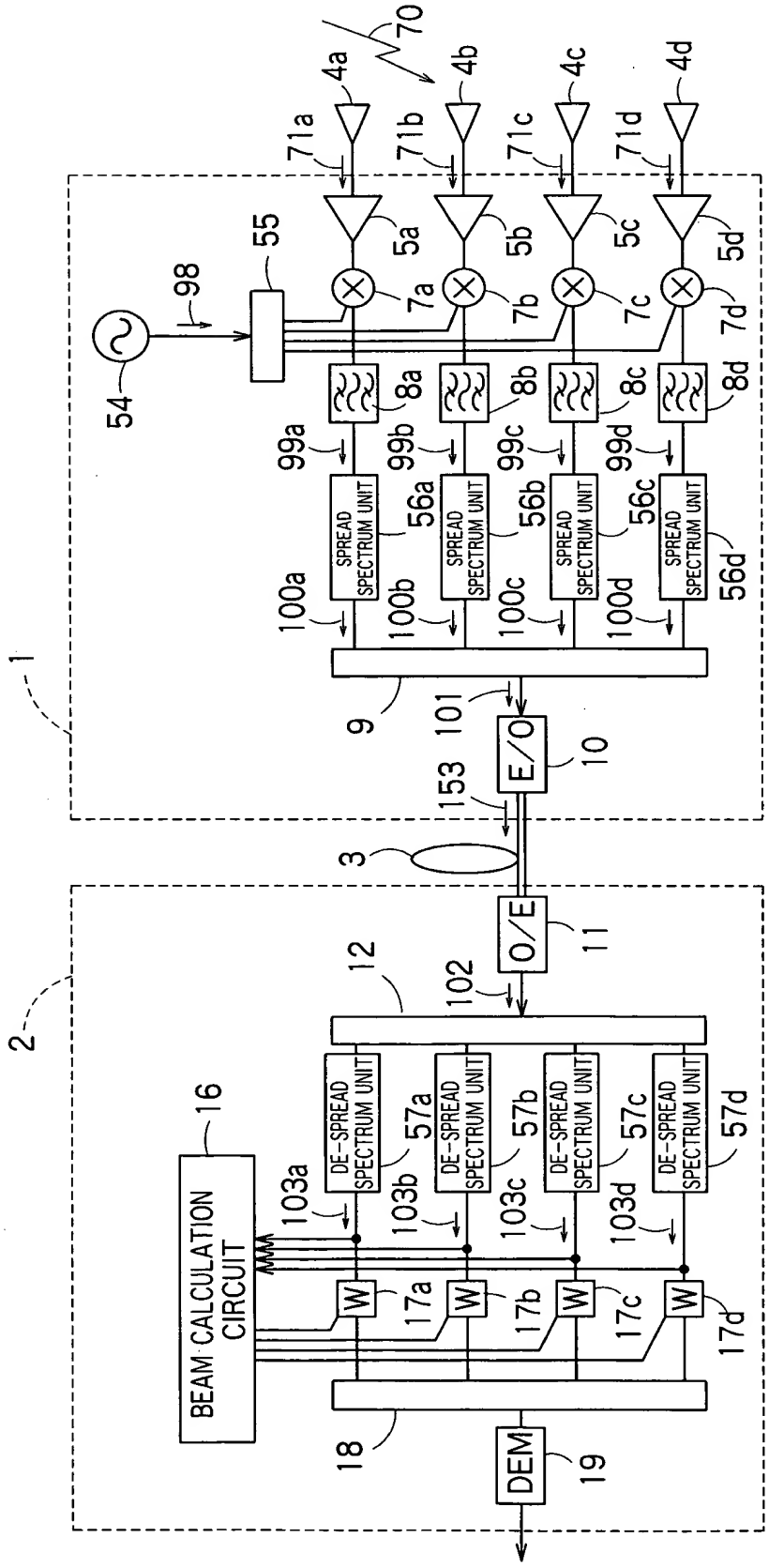
1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
16
17a
17b
17c
17d
18
19
54
55
70
71a
71b
71c
71d
98
99a
99b
99c
99d
100a
100b
100c
100d
101
102
103a
103b
103c
103d
153
56a
56b
56c
56d
57a
57b
57c
57d
SPREAD SPECTRUM UNIT
DE-SPREAD SPECTRUM UNIT
E/O
O/E
W
DEM
BEAM CALCULATION CIRCUIT

FIG. 13

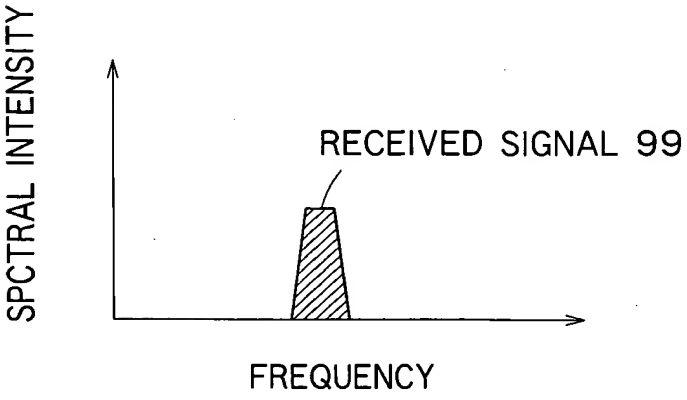

FIG. 14A

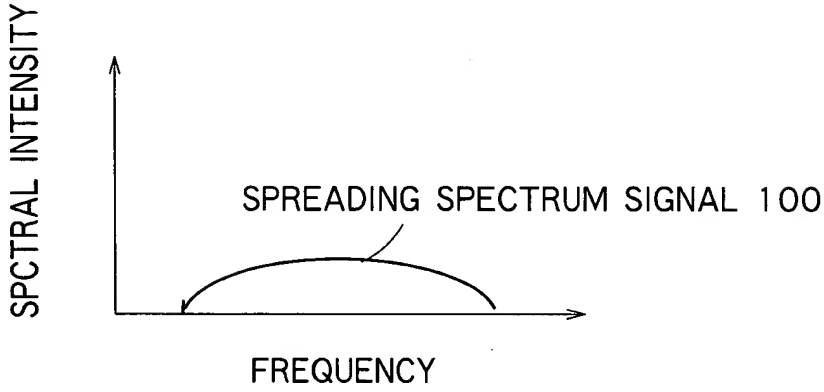

FIG. 14B

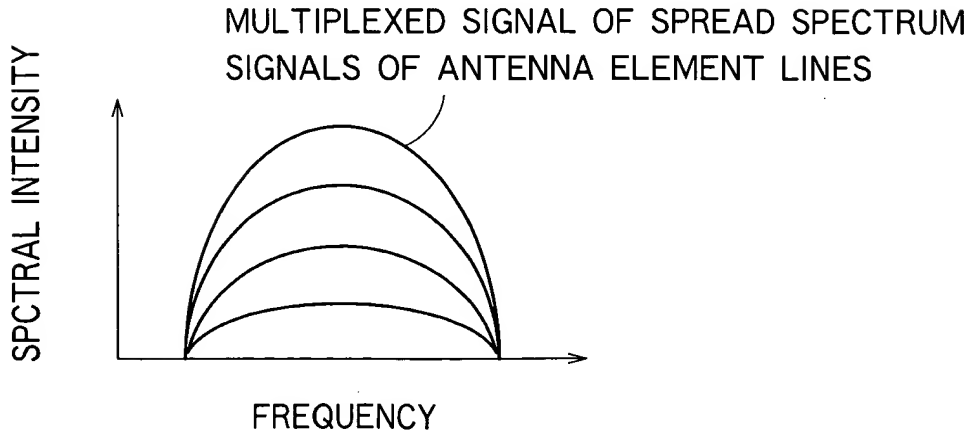

FIG. 14C

0027650 "2940950

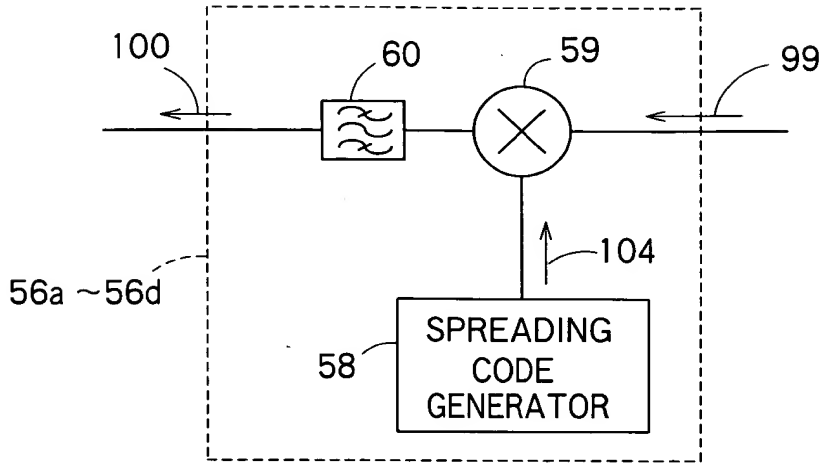

FIG. 15A

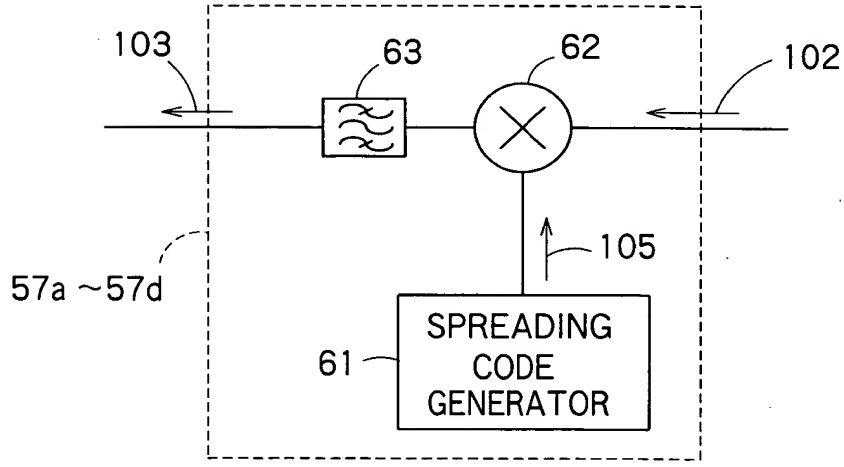

FIG. 15B

0956045 05/12/00

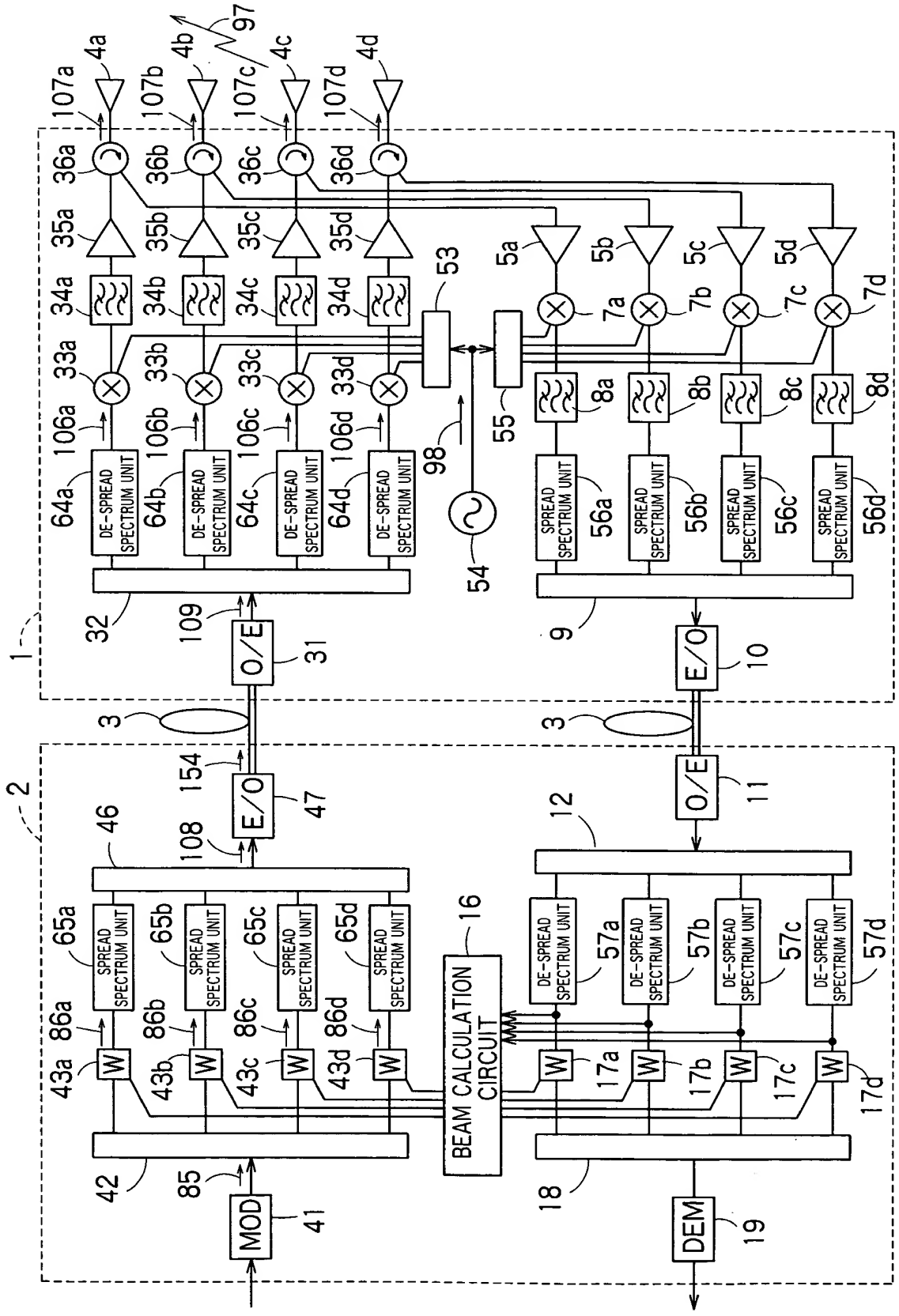
1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
9
10
11
12
16
17a
17b
17c
17d
18
19
31
32
41
42
46
47
53
54
55
97
98
107a
107b
107c
107d
109
154
DE-SPREAD SPECTRUM UNIT
SPREAD SPECTRUM UNIT
BEAM CALCULATION CIRCUIT
MOD
DEM
O/E
E/O
W

FIG. 16

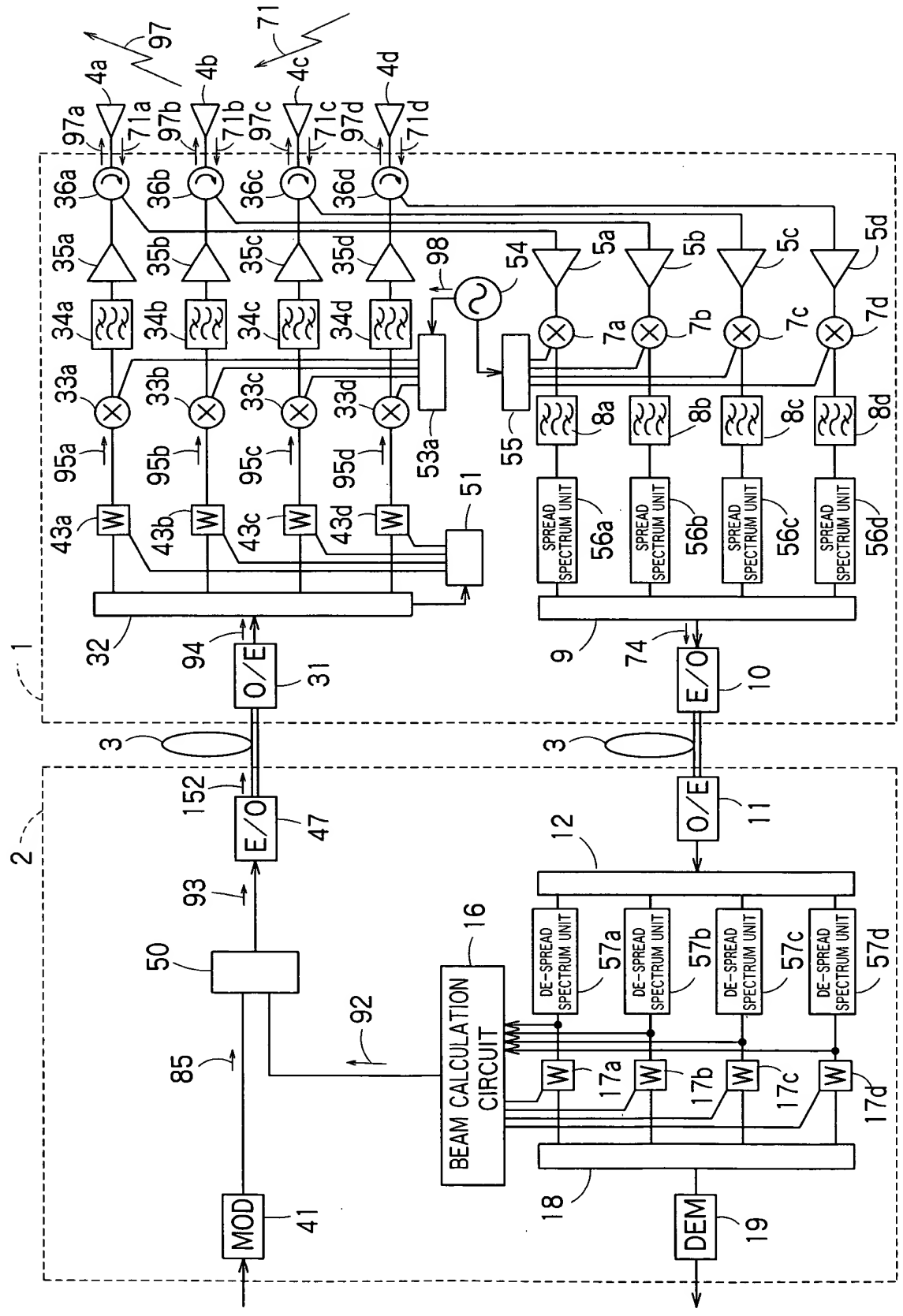
1
2
3
4a
4b
4c
4d
5a
5b
5c
5d
7a
7b
7c
7d
8a
8b
8c
8d
9
10
11
12
16
17a
17b
17c
17d
18
19
31
32
33a
33b
33c
33d
34a
34b
34c
34d
35a
35b
35c
35d
36a
36b
36c
36d
41
43a
43b
43c
43d
47
50
51
53a
54
55
56a
56b
56c
56d
57a
57b
57c
57d
71
71a
71b
71c
71d
74
85
92
93
94
95a
95b
95c
95d
97
97a
97b
97c
97d
98
152
BEAM CALCULATION CIRCUIT
DE-SPREAD SPECTRUM UNIT
SPREAD SPECTRUM UNIT
DEM
E/O
MOD
O/E
W

FIG. 17

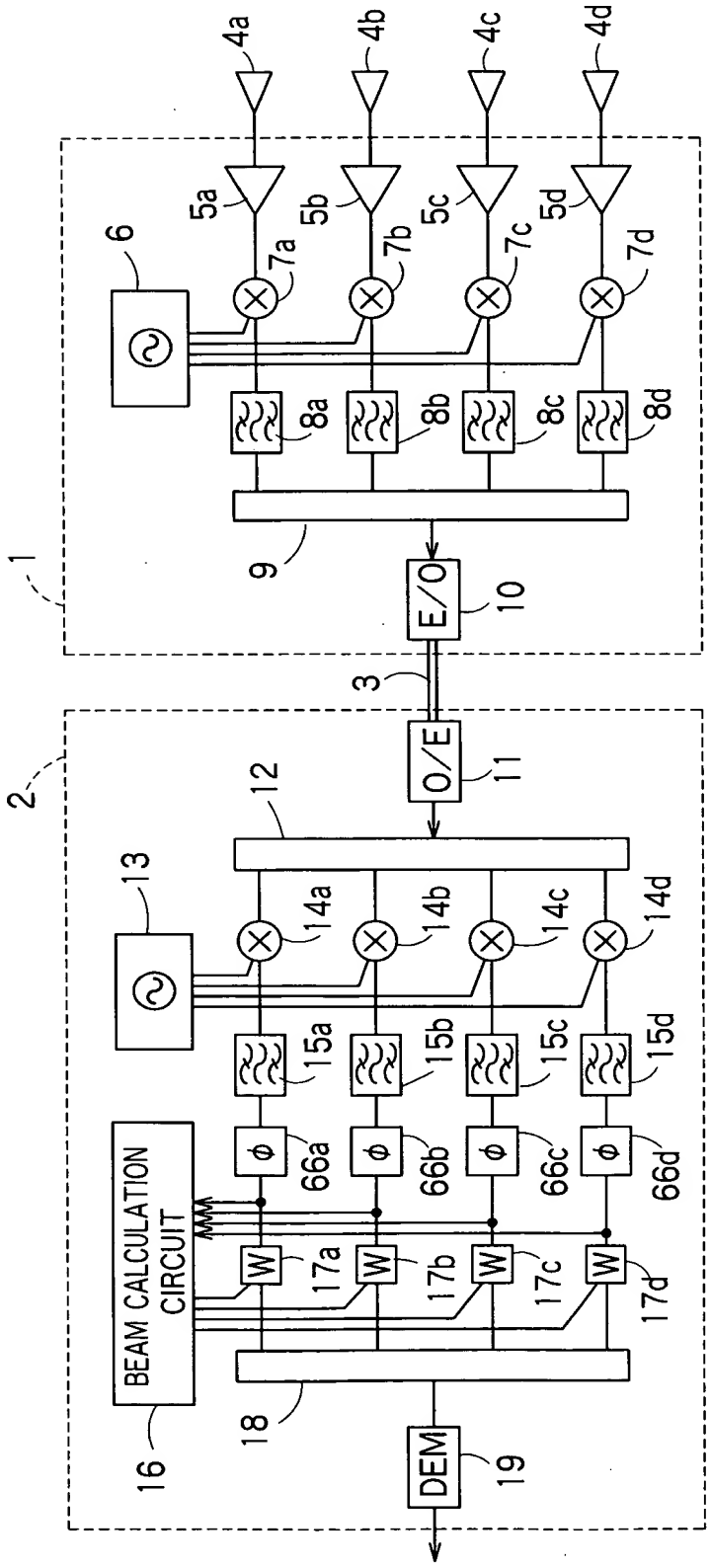

FIG. 18

0027650 "/94-05-50

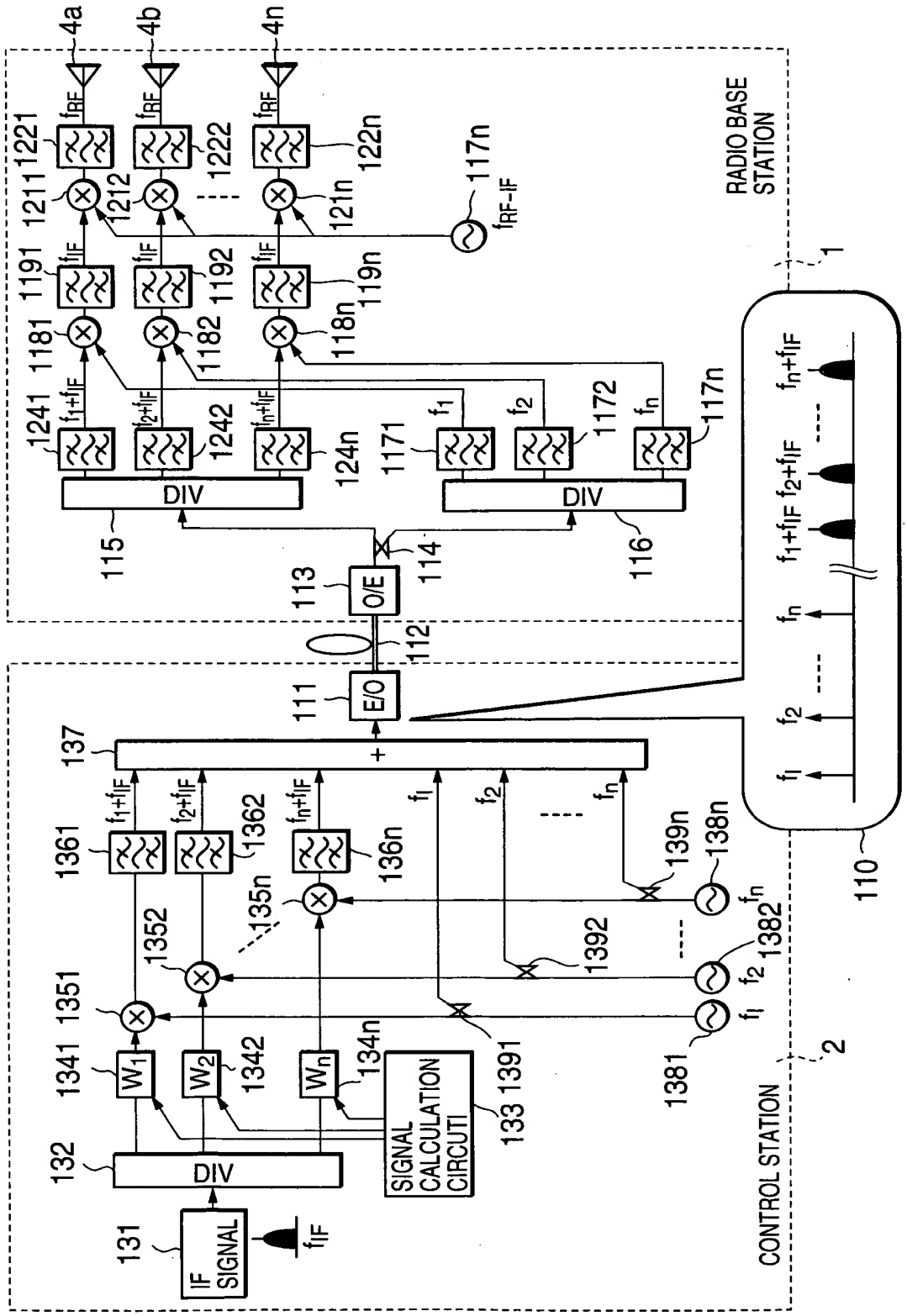
RADIO BASE STATION
CONTROL STATION
DIV
SIGNAL CALCULATION CIRCUIT
IF SIGNAL
O/E
E/O

FIG.19

f_1
f_1+f_{IF}
f_2
f_2+f_{IF}
f_n
f_n+f_{IF}

FIG.20

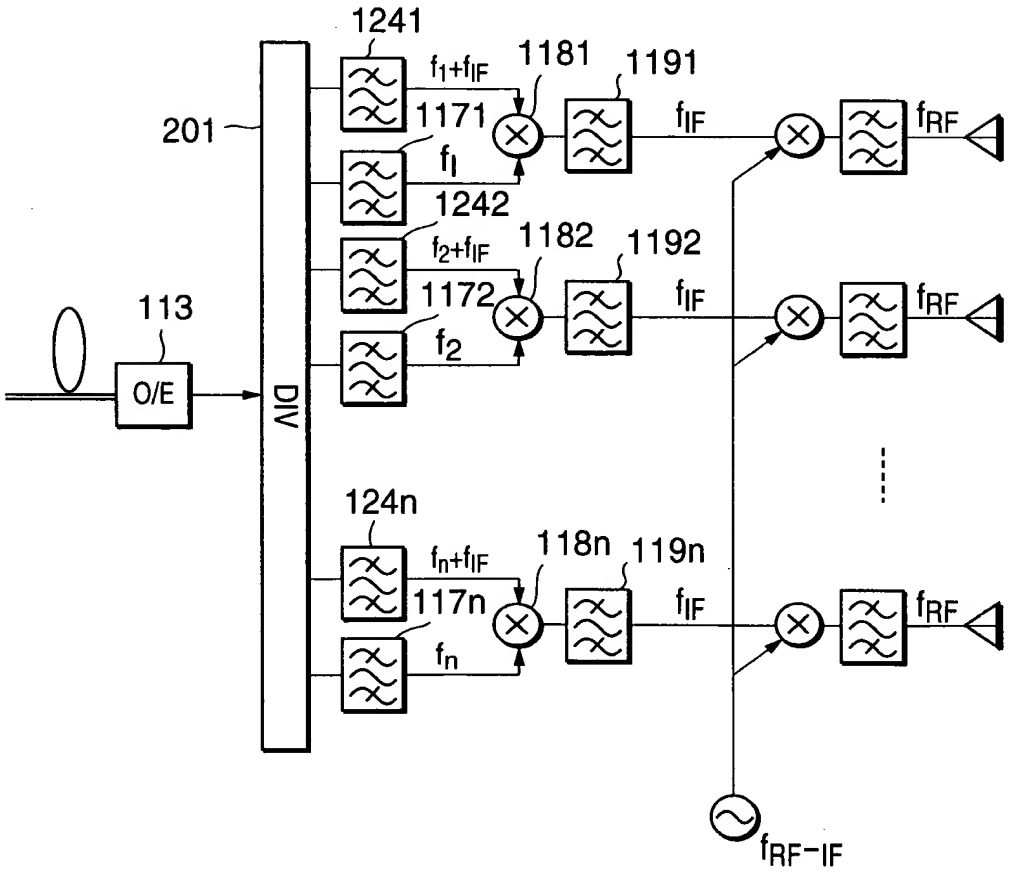
1241
1181
1191
201
1171
f_1+f_{IF}
f_{IF}
f_{RF}
f_1
1242
1182
1192
113
1172
f_2+f_{IF}
O/E
DIV
f_2
124n
118n
119n
f_n+f_{IF}
117n
f_n
f_{RF-IF}

FIG.21

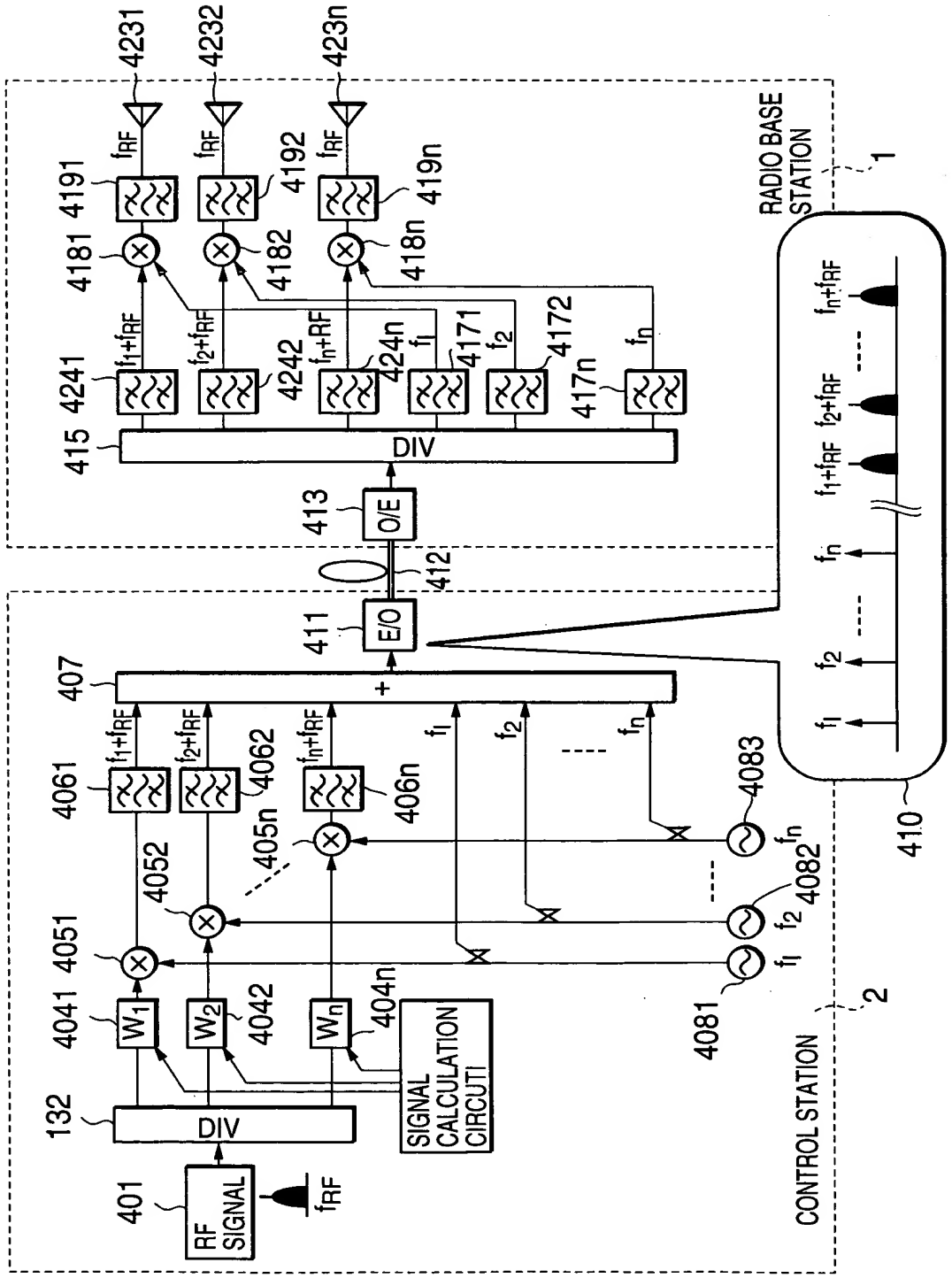
RADIO BASE STATION
1
CONTROL STATION
2
RF SIGNAL
DIV
SIGNAL CALCULATION CIRCUIT
O/E
E/O
DIV
4231
4232
423n
4191
4192
419n
4181
4182
418n
4241
4242
424n
4171
4172
417n
415
413
412
411
407
4061
4062
406n
4052
405n
4051
4041
4042
404n
132
401
4083
4082
4081
410

FIG.22

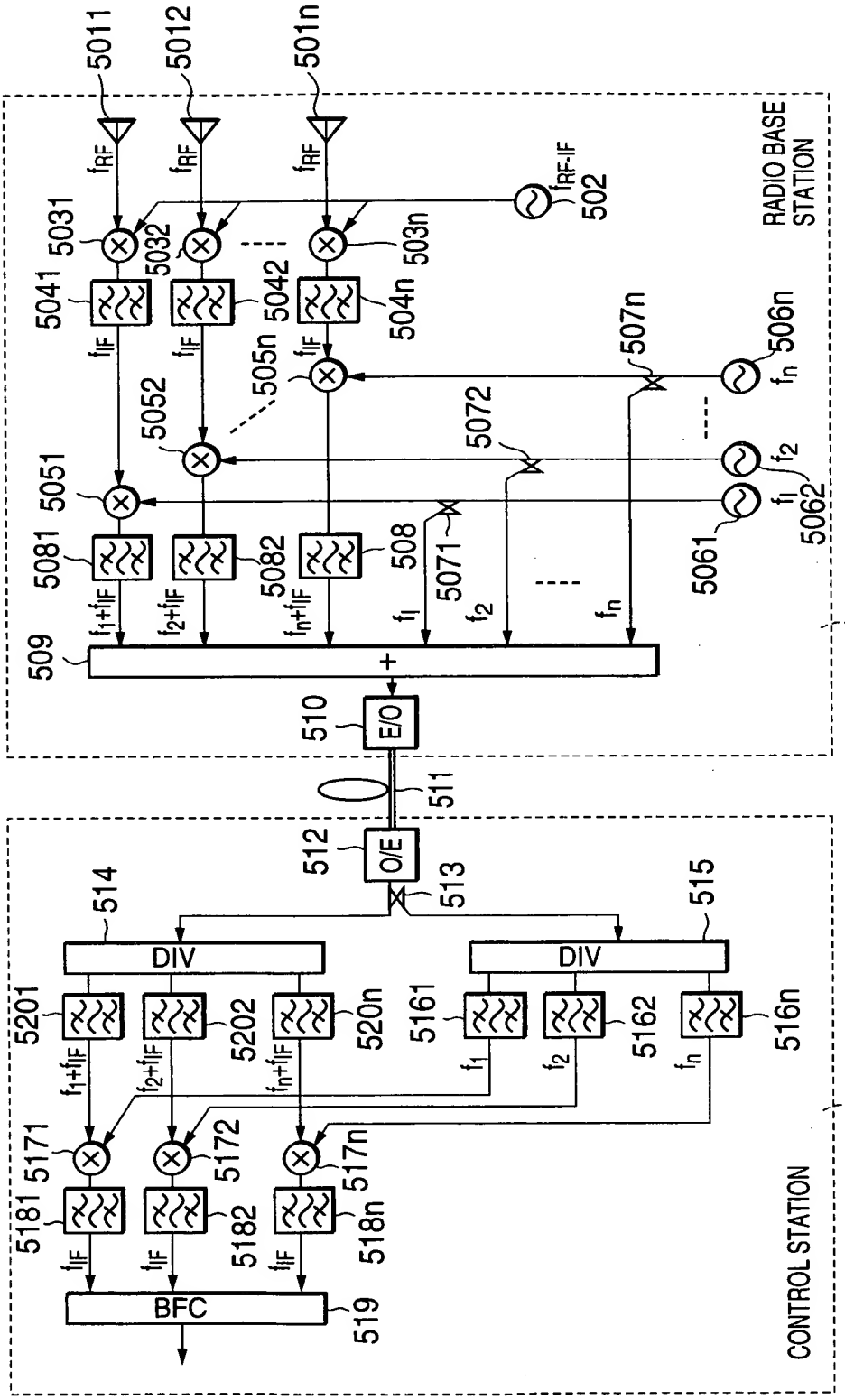
RADIO BASE STATION
CONTROL STATION
5011
5012
501n
f_{RF}
f_{RF-IF}
502
5031
5032
503n
5041
5042
504n
f_{IF}
505n
5052
507n
506n
f_n
5072
f_2
5051
f_1
5062
5061
5081
5082
508
5071
f_1+f_{IF}
f_2+f_{IF}
f_n+f_{IF}
509
+
510
E/O
511
512
O/E
513
514
515
DIV
5201
5202
520n
5161
5162
516n
5171
5172
517n
5181
5182
518n
BFC
519
1
2

FIG.23

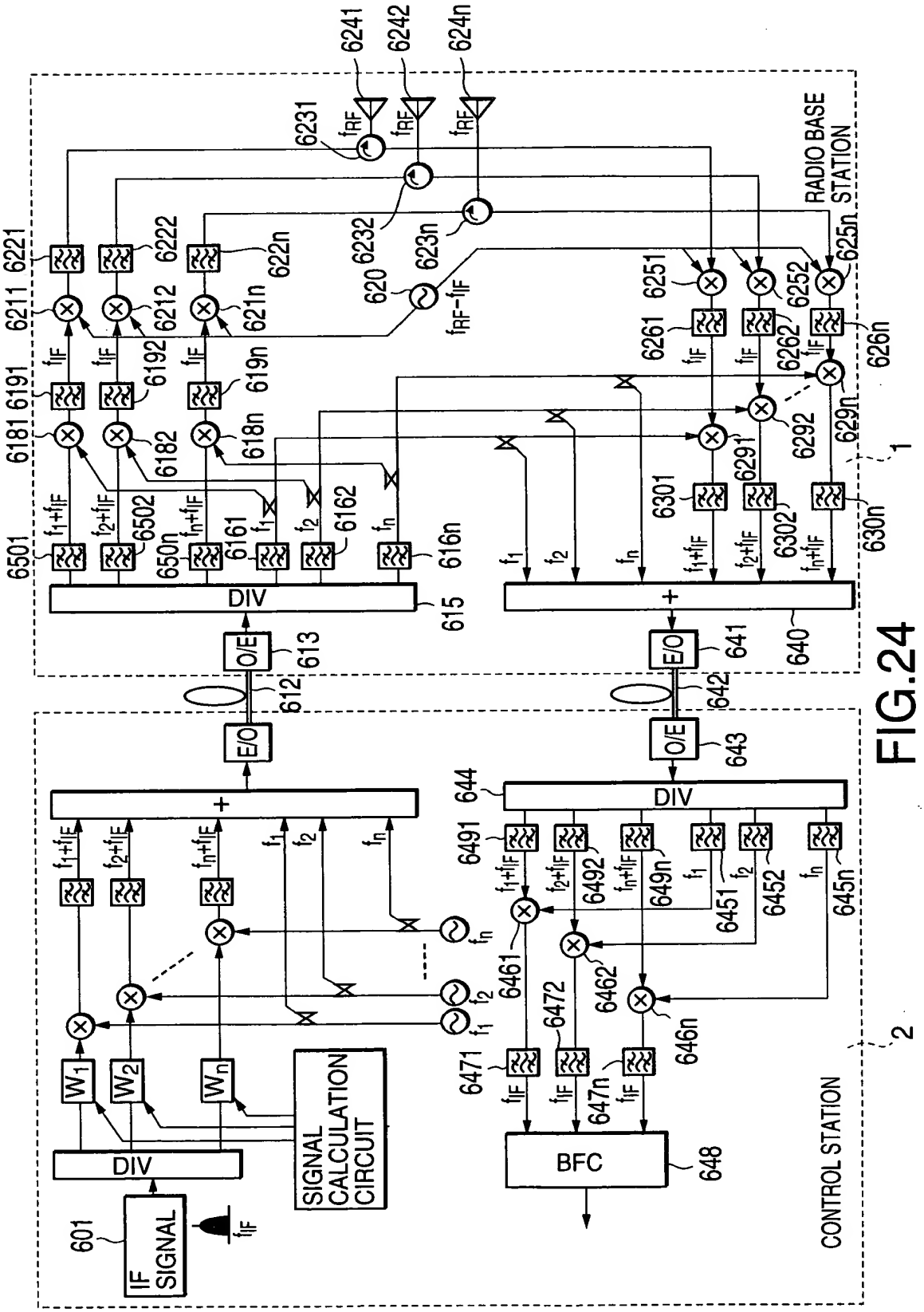
RADIO BASE STATION
CONTROL STATION
DIV
SIGNAL CALCULATION CIRCUIT
IF SIGNAL
BFC
E/O
O/E

FIG.24

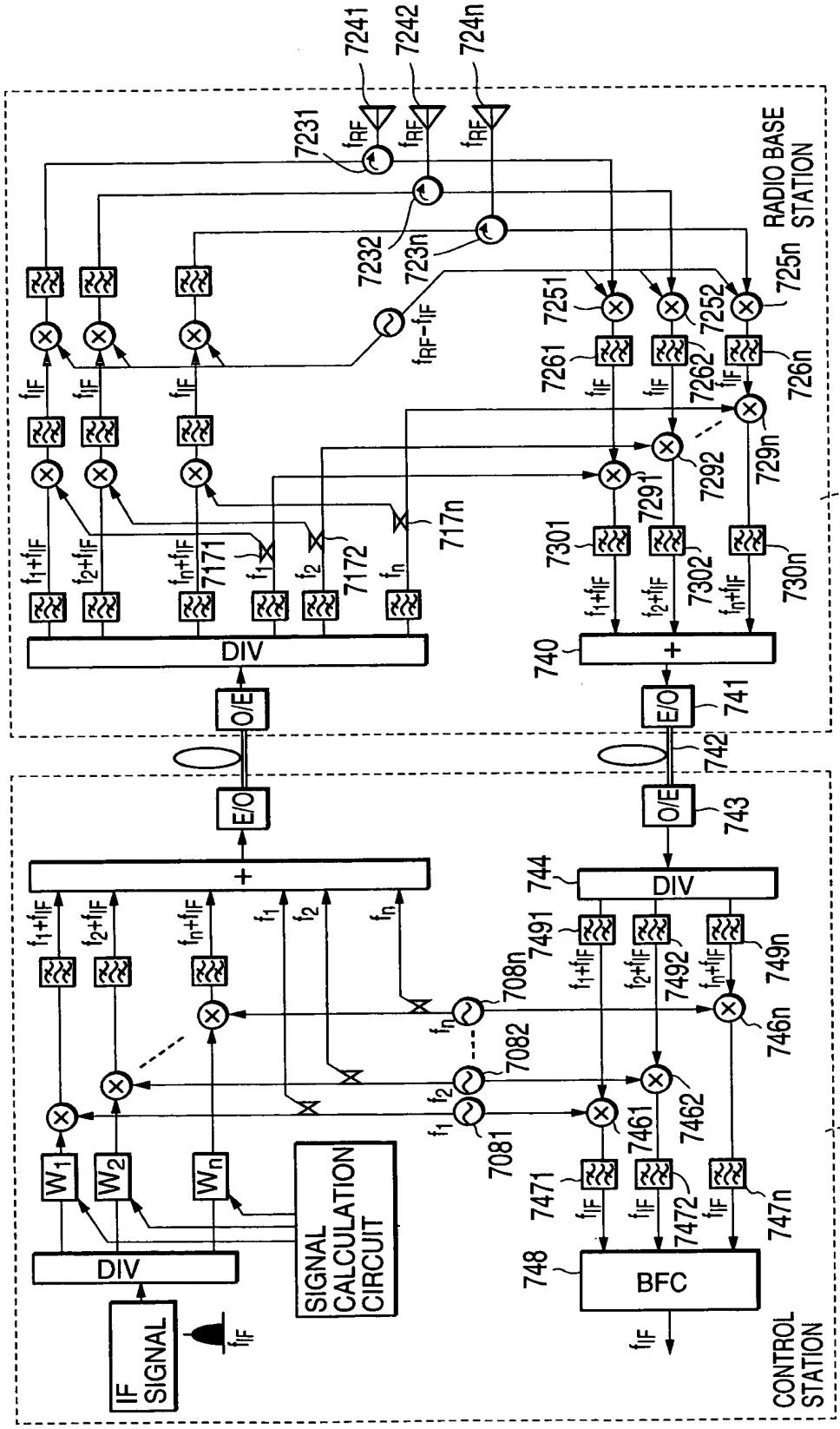
RADIO BASE STATION
CONTROL STATION
DIV
SIGNAL CALCULATION CIRCUIT
IF SIGNAL
BFC
O/E
E/O
1
2

FIG.25

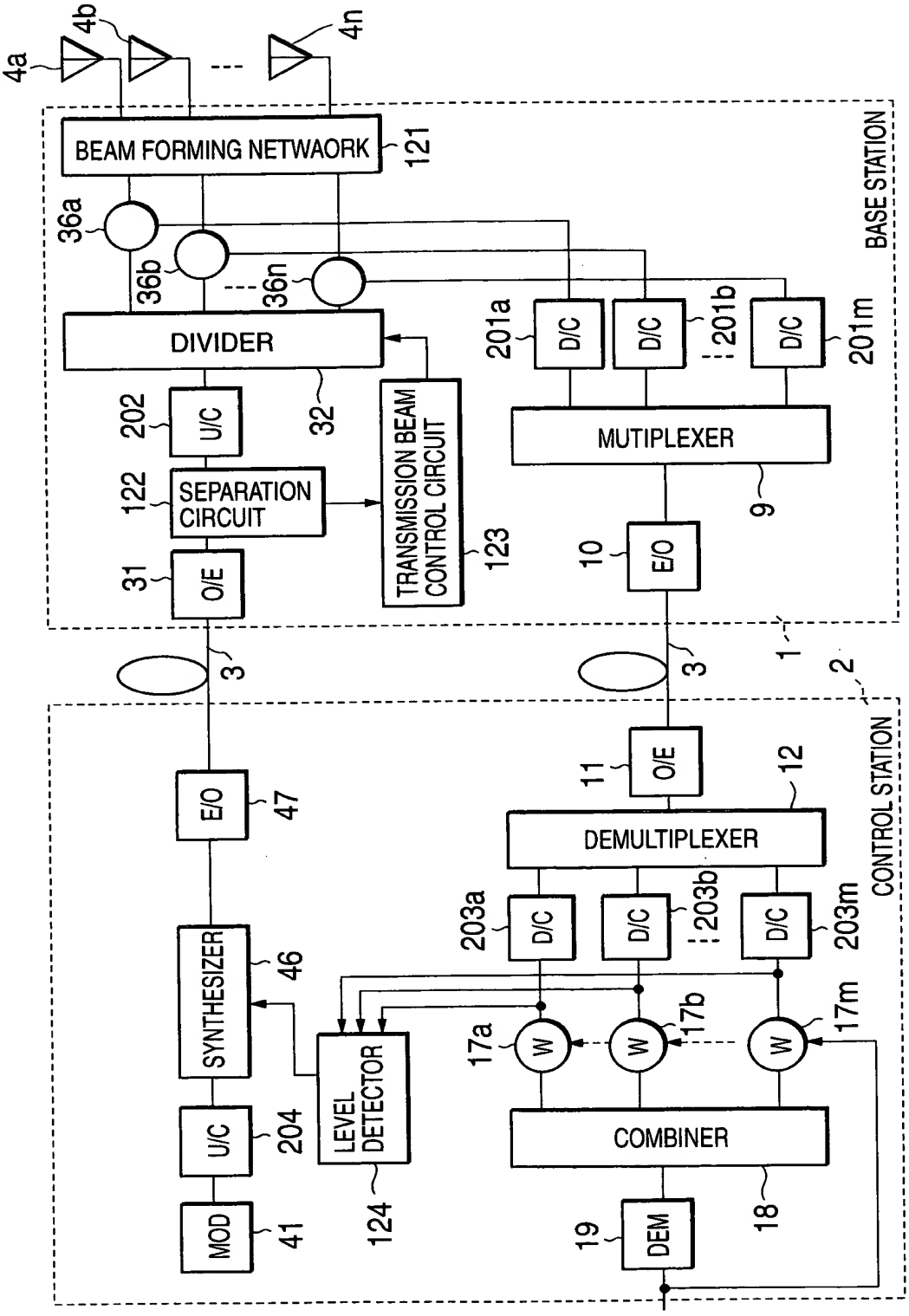
4a
4b
4n
BEAM FORMING NETWAORK
121
36a
36b
36n
DIVIDER
32
202
U/C
122
SEPARATION CIRCUIT
31
O/E
TRANSMISSION BEAM CONTROL CIRCUIT
123
201a
D/C
D/C
201b
D/C
201m
MUTIPLEXER
9
10
E/O
BASE STATION
1
2
3
3
E/O
47
SYNTHESIZER
46
U/C
204
MOD
41
LEVEL DETECTOR
124
11
O/E
12
DEMULTIPLEXER
203a
D/C
D/C
203b
D/C
203m
17a
W
W
17b
W
17m
COMBINER
18
19
DEM
CONTROL STATION

FIG.26

0027650 "2540950

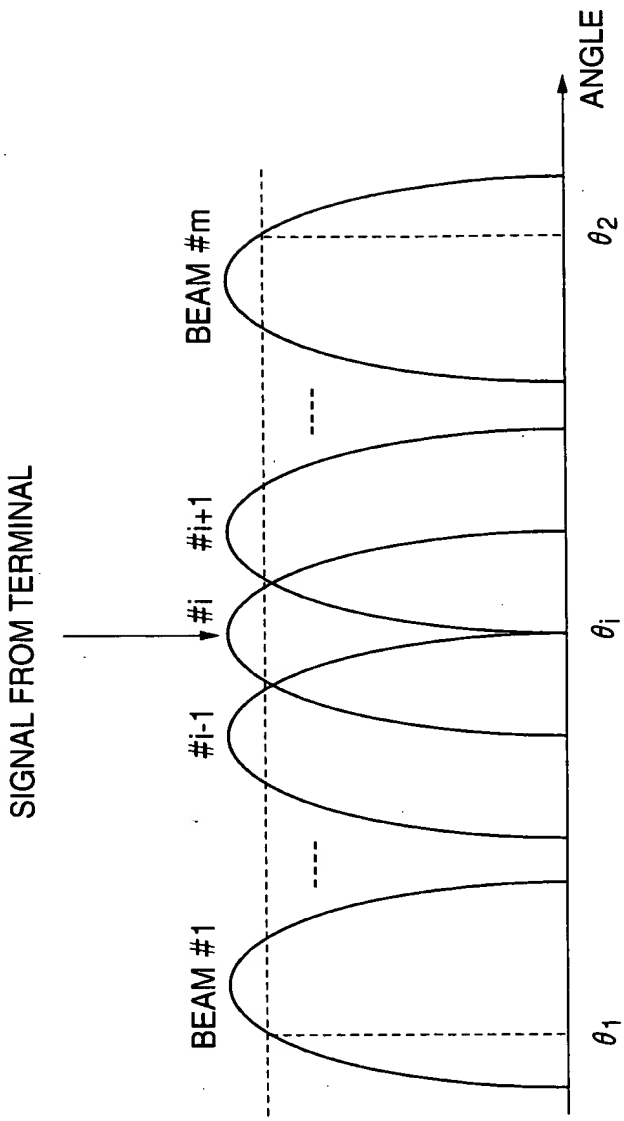

FIG.27A

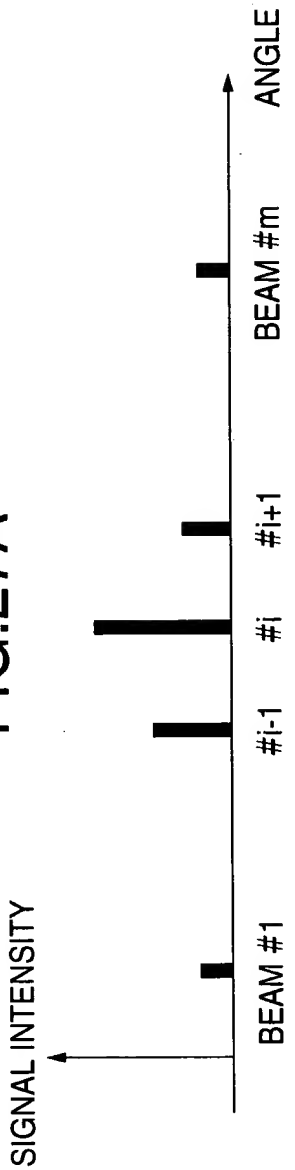

FIG.27B

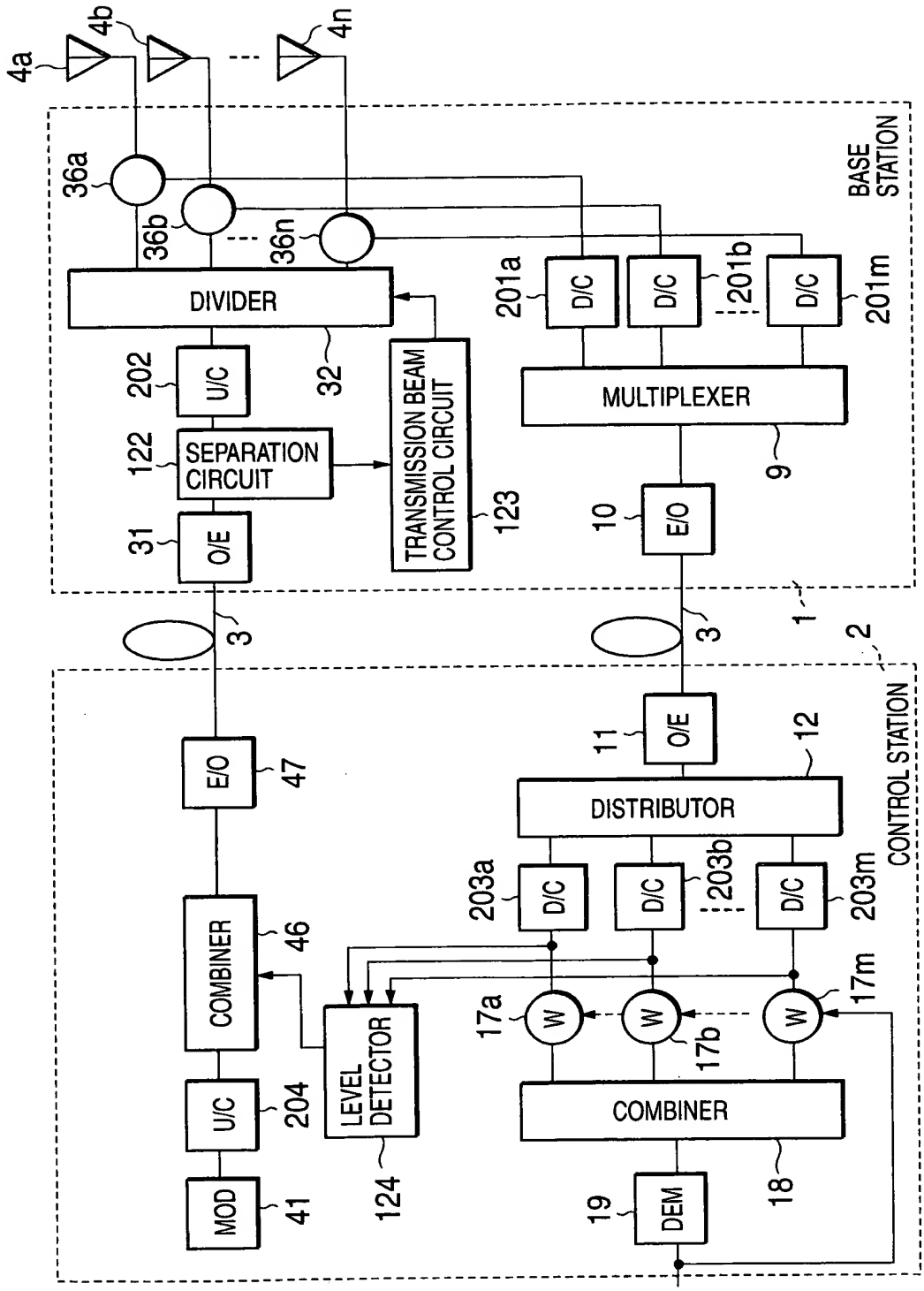
4a
4b
4n
36a
36b
36n
DIVIDER
32
202
U/C
122
SEPARATION CIRCUIT
31
O/E
TRANSMISSION BEAM CONTROL CIRCUIT
123
201a
D/C
201b
201m
MULTIPLEXER
9
10
E/O
BASE STATION
1
3
2
CONTROL STATION
11
O/E
12
DISTRIBUTOR
203a
203b
203m
17a
17b
17m
W
COMBINER
18
19
DEM
47
E/O
46
COMBINER
204
U/C
41
MOD
124
LEVEL DETECTOR

FIG.28

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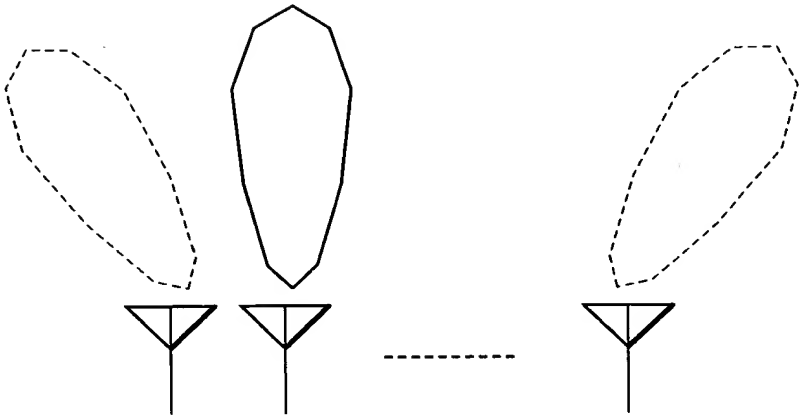

FIG.29A

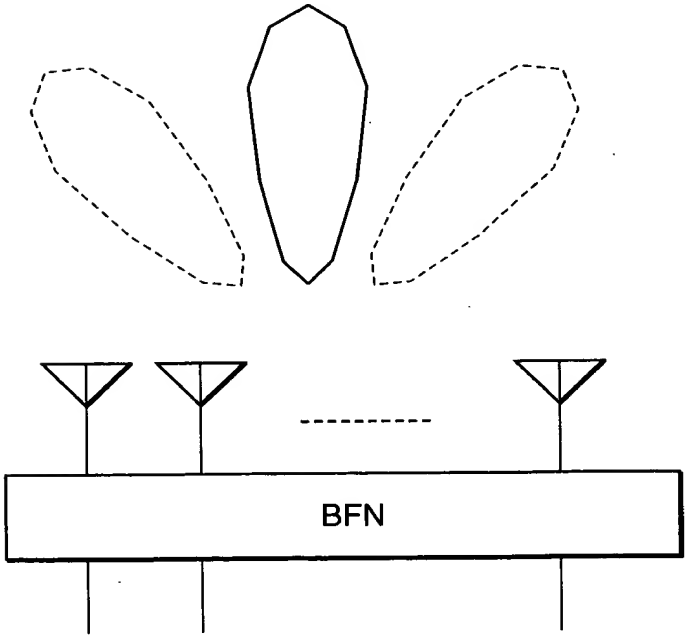

FIG.29B

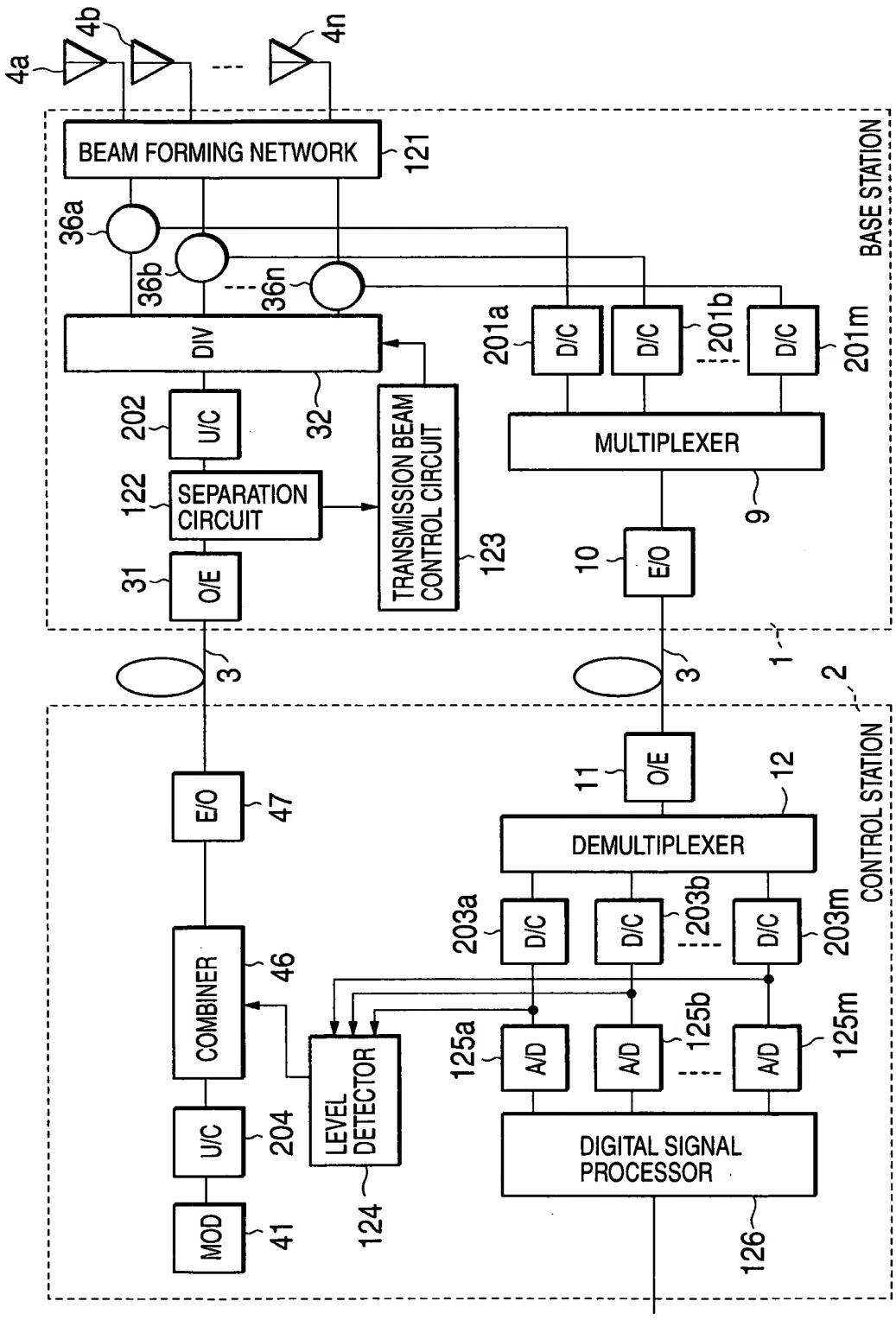
4a
4b
4n
BEAM FORMING NETWORK
121
36a
36b
36n
DIV
32
202
U/C
122
SEPARATION CIRCUIT
31
O/E
TRANSMISSION BEAM CONTROL CIRCUIT
123
201a
D/C
201b
201m
MULTIPLEXER
9
10
E/O
BASE STATION
1
3
2
11
O/E
12
DEMULTIPLEXER
203a
203b
203m
125a
125b
125m
A/D
DIGITAL SIGNAL PROCESSOR
126
CONTROL STATION
47
46
COMBINER
204
LEVEL DETECTOR
124
41
MOD

FIG.30

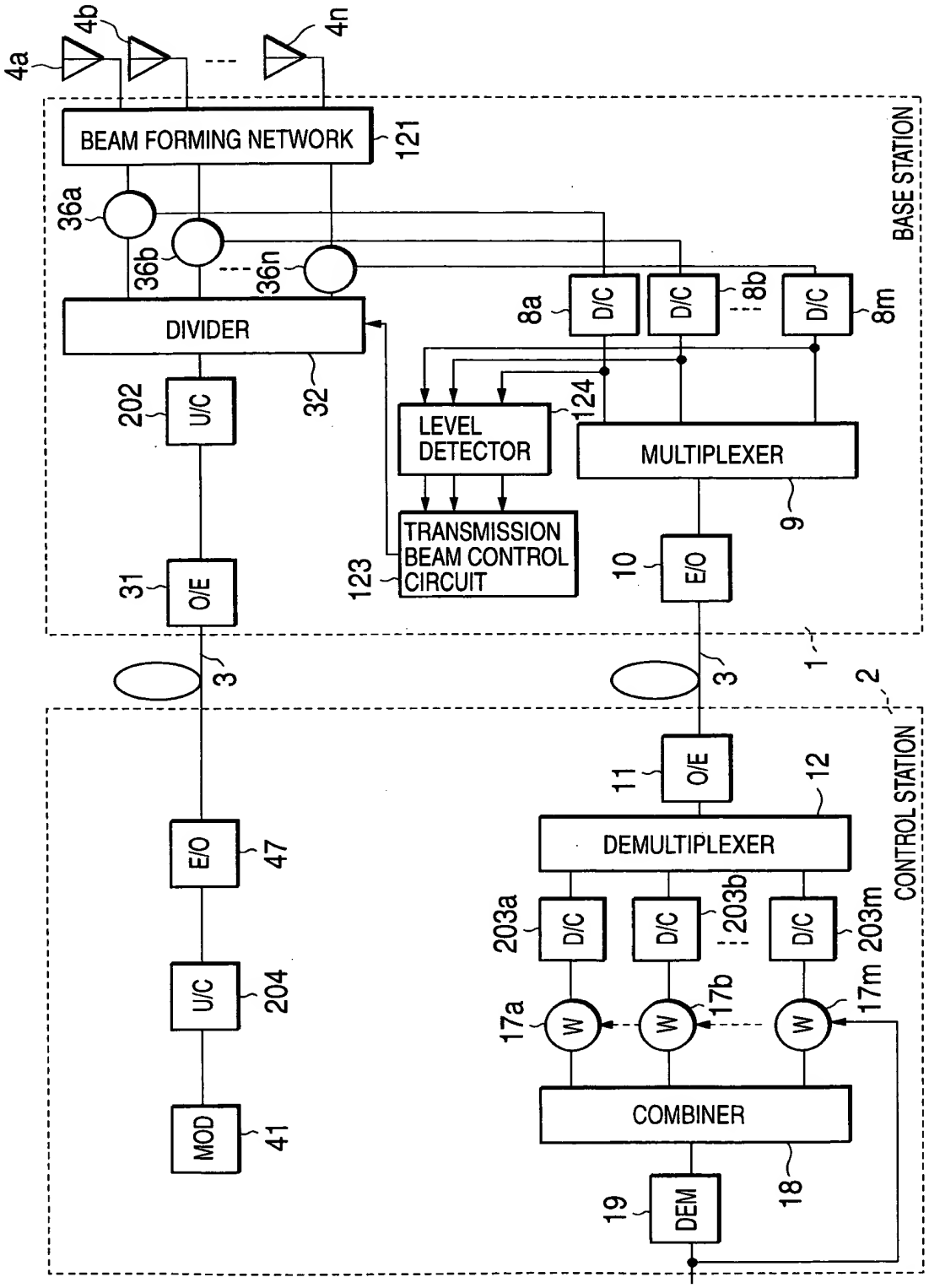
4a
4b
4n
BEAM FORMING NETWORK
121
36a
36b
36n
DIVIDER
32
202
U/C
31
O/E
3
BASE STATION
8a
D/C
8b
8m
LEVEL DETECTOR
124
MULTIPLEXER
9
TRANSMISSION BEAM CONTROL CIRCUIT
123
10
E/O
1
2
11
O/E
12
DEMULTIPLEXER
203a
203b
203m
17a
17b
17m
W
COMBINER
18
19
DEM
CONTROL STATION
47
204
41
MOD

FIG.31

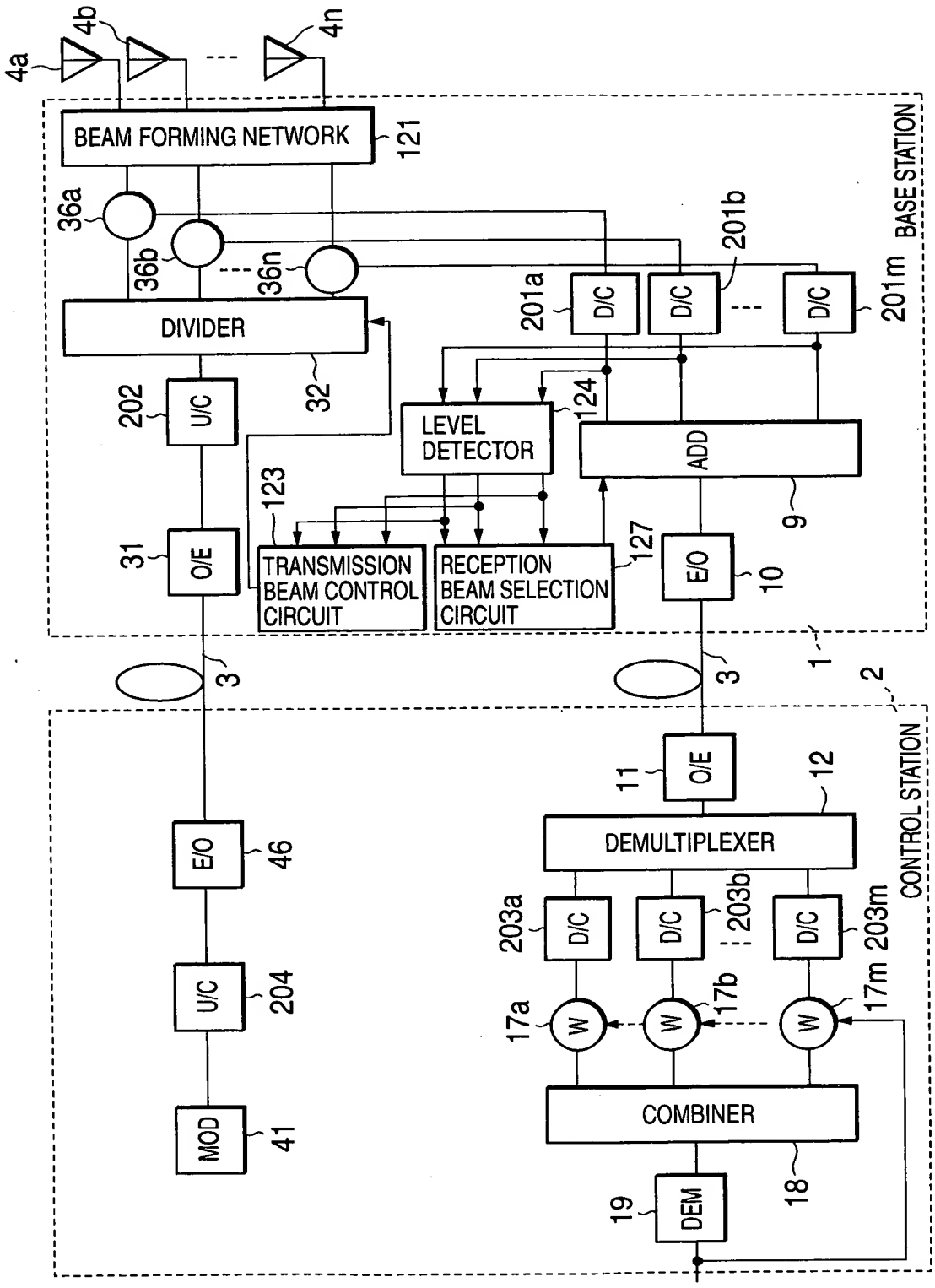
4a
4b
4n
BEAM FORMING NETWORK
121
36a
36b
36n
DIVIDER
32
202
U/C
31
O/E
123
TRANSMISSION BEAM CONTROL CIRCUIT
LEVEL DETECTOR
124
RECEPTION BEAM SELECTION CIRCUIT
127
201a
D/C
201b
201m
ADD
9
E/O
10
BASE STATION
1
3
3
2
11
O/E
12
DEMULTIPLEXER
203a
203b
203m
17a
17b
17m
W
COMBINER
18
19
DEM
CONTROL STATION
E/O
46
U/C
204
MOD
41

FIG.32

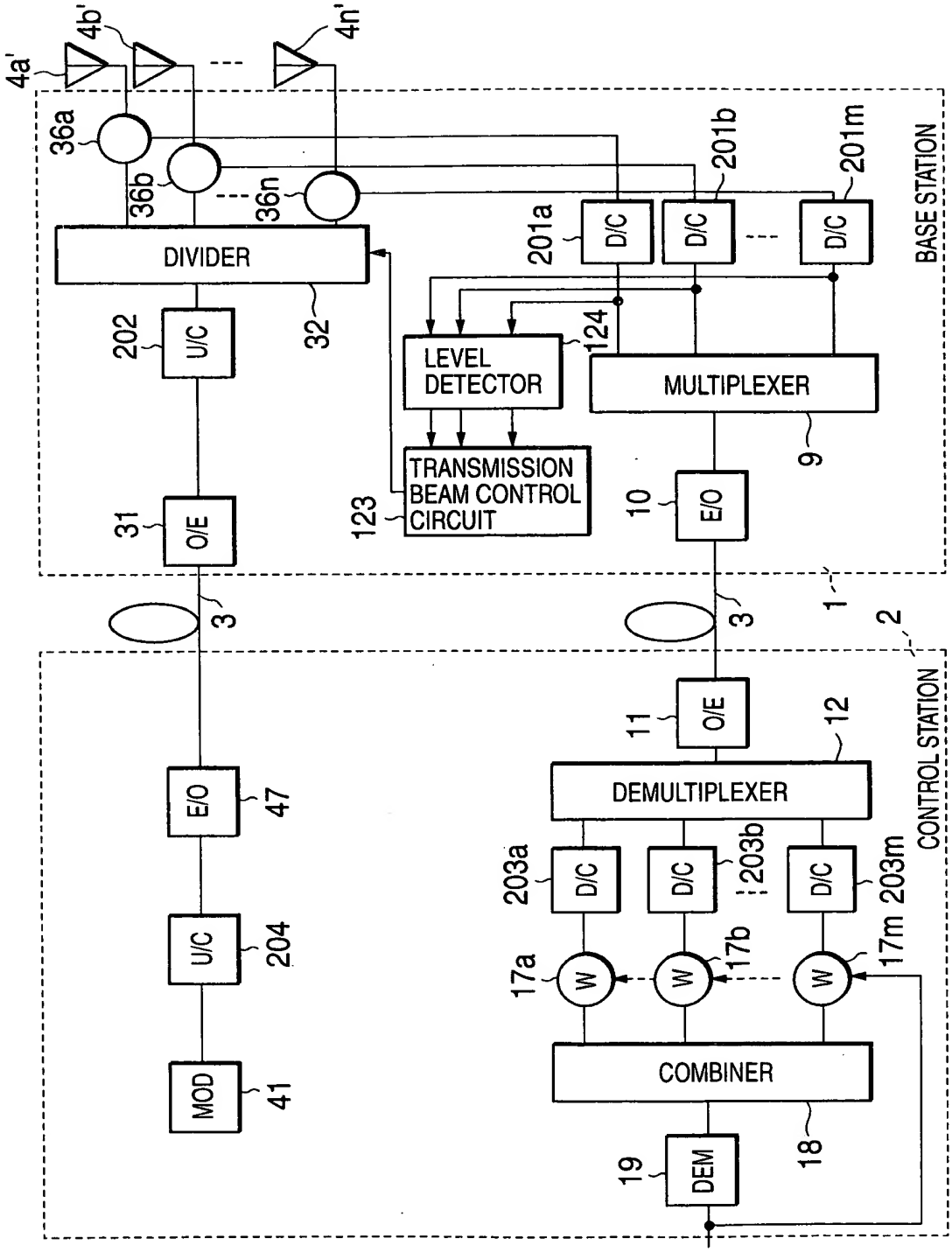
4a'
4b'
4n'
36a
36b
36n
DIVIDER
32
202
U/C
31
O/E
3
BASE STATION
201a
D/C
201b
201m
LEVEL DETECTOR
124
MULTIPLEXER
9
TRANSMISSION BEAM CONTROL CIRCUIT
123
10
E/O
1
2
CONTROL STATION
11
O/E
12
DEMULTIPLEXER
203a
203b
203m
17a
17b
17m
W
COMBINER
18
19
DEM
E/O
47
U/C
204
MOD
41

FIG.33

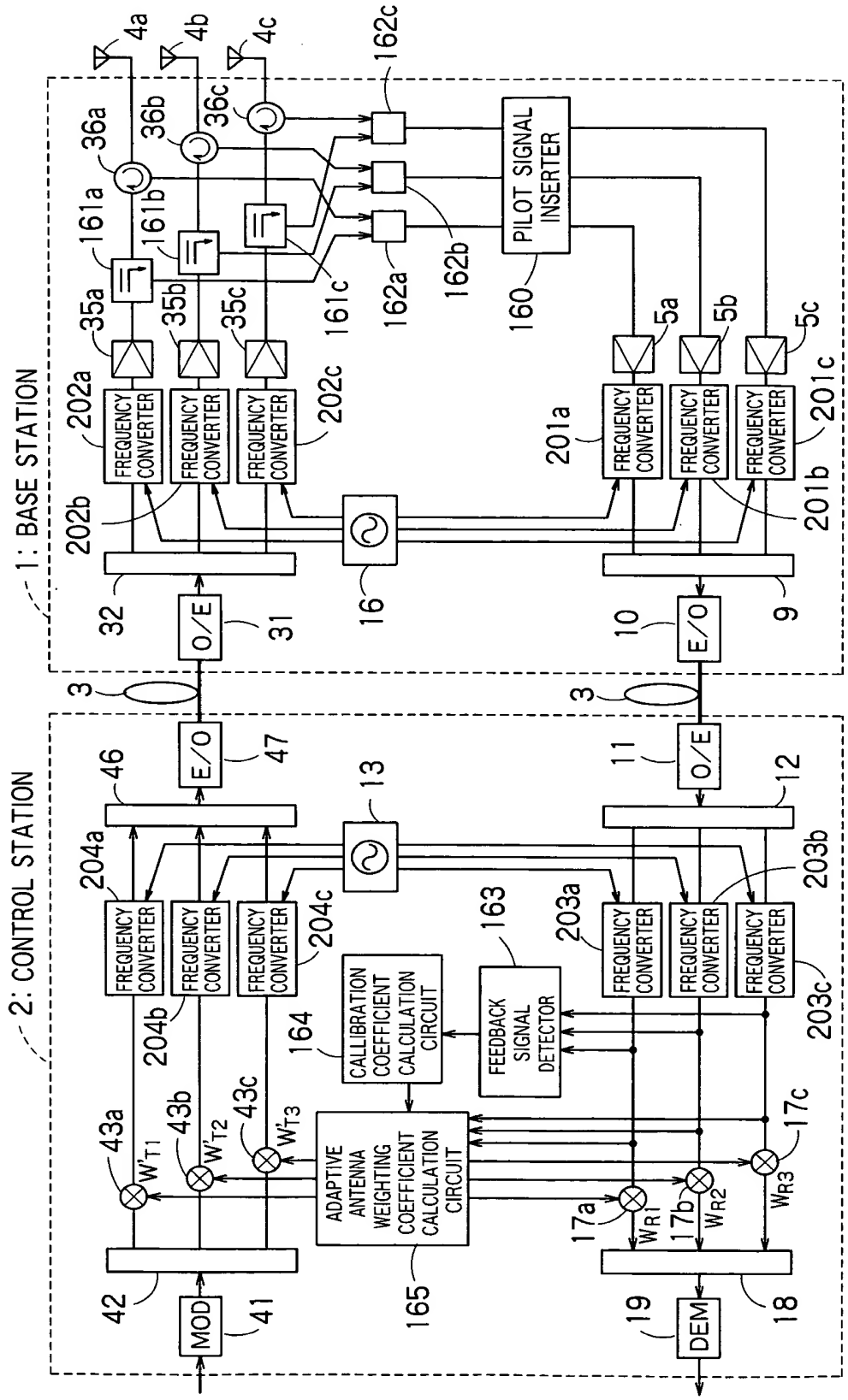
1: BASE STATION
2: CONTROL STATION
4a
4b
4c
36a
36b
36c
161a
161b
161c
162a
162b
162c
35a
35b
35c
PILOT SIGNAL INSERTER
160
5a
5b
5c
202a
202b
202c
201a
201b
201c
FREQUENCY CONVERTER
32
O/E
31
16
10
E/O
9
3
46
E/O
47
13
11
O/E
12
204a
204b
204c
203a
203b
203c
163
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
164
FEEDBACK SIGNAL DETECTOR
43a
43b
43c
W'_{T1}
W'_{T2}
W'_{T3}
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
165
17a
17b
17c
W_{R1}
W_{R2}
W_{R3}
42
MOD
41
19
DEM
18

FIG. 34

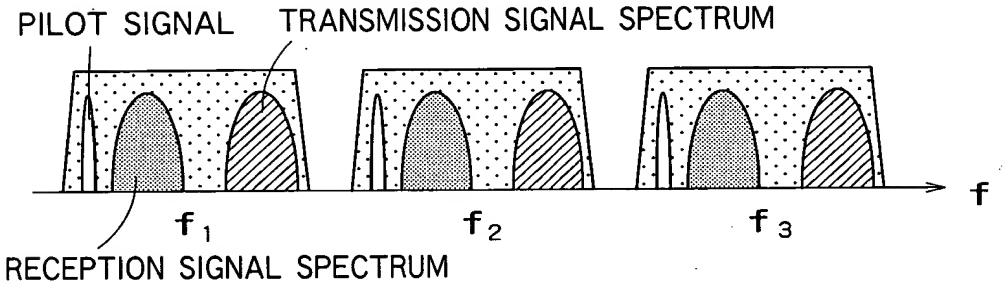
PILOT SIGNAL
TRANSMISSION SIGNAL SPECTRUM
f
f1
f2
f3
RECEPTION SIGNAL SPECTRUM

FIG. 35

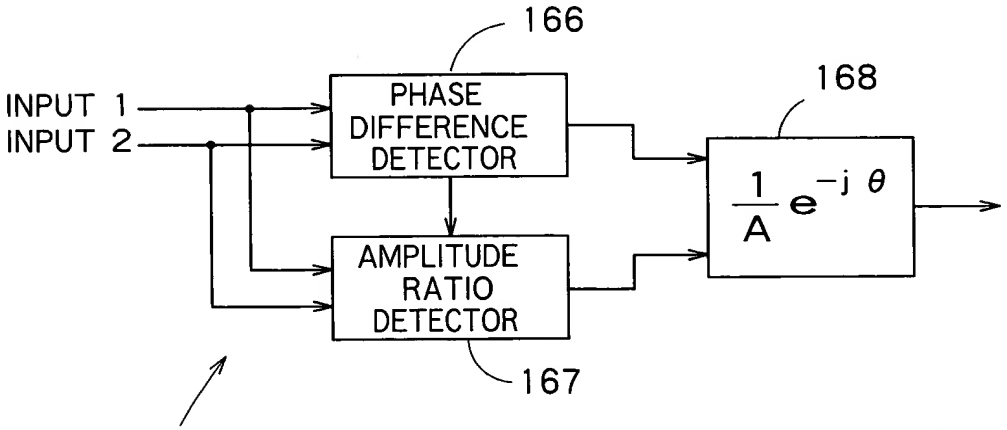
166
168
INPUT 1
INPUT 2
PHASE DIFFERENCE DETECTOR
AMPLITUDE RATIO DETECTOR
1/A e^-jθ
167
164: CALIBRATION COEFFICIENT CALCULATION CIRCUIT

FIG. 36

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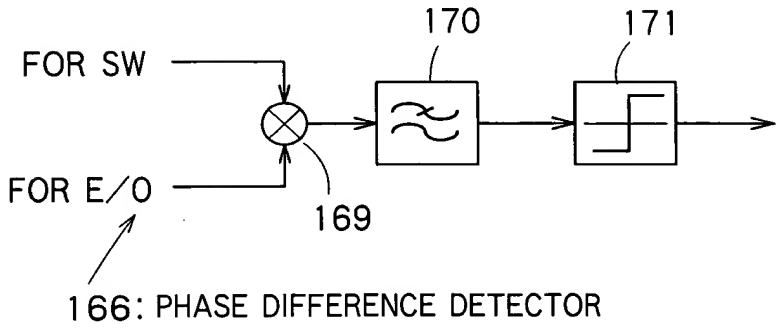

FIG. 37

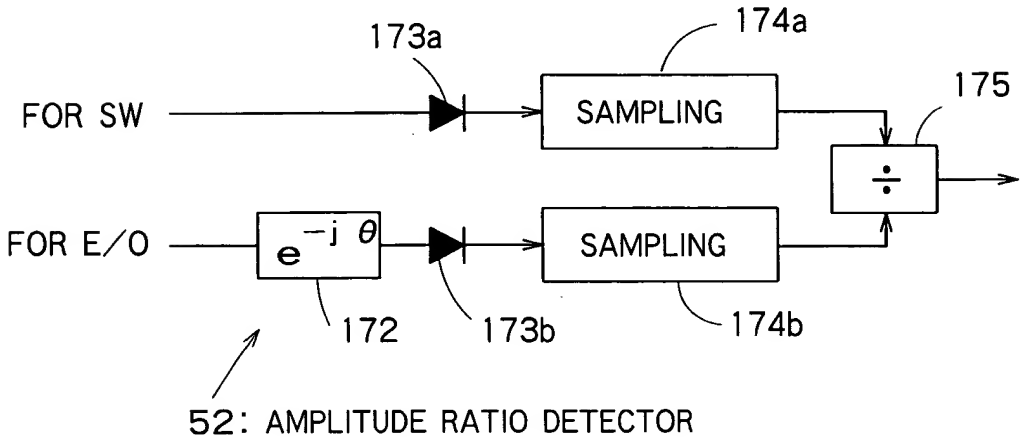

FIG. 38

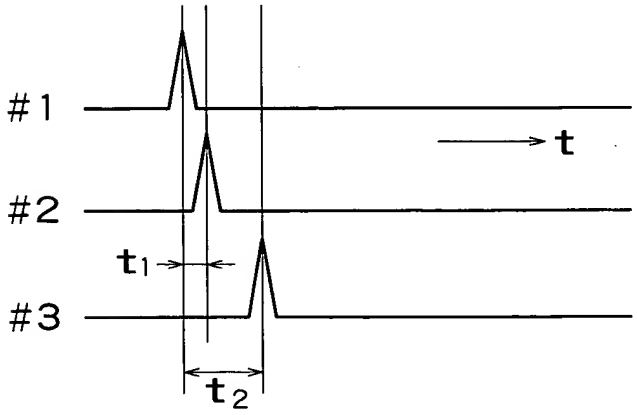

FIG. 39

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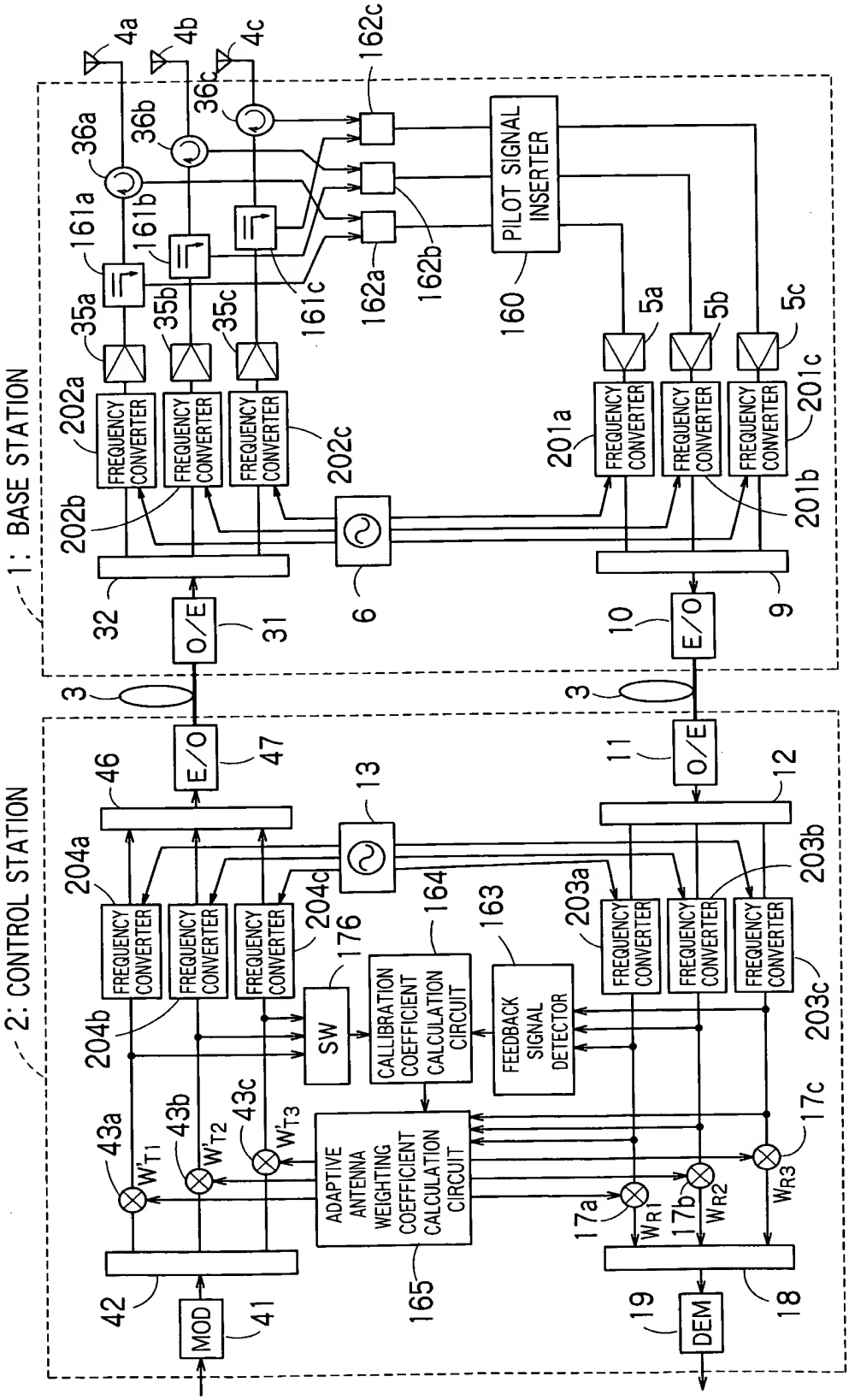
1: BASE STATION
2: CONTROL STATION
FREQUENCY CONVERTER
PILOT SIGNAL INSERTER
O/E
E/O
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
MOD
DEM

FIG. 40

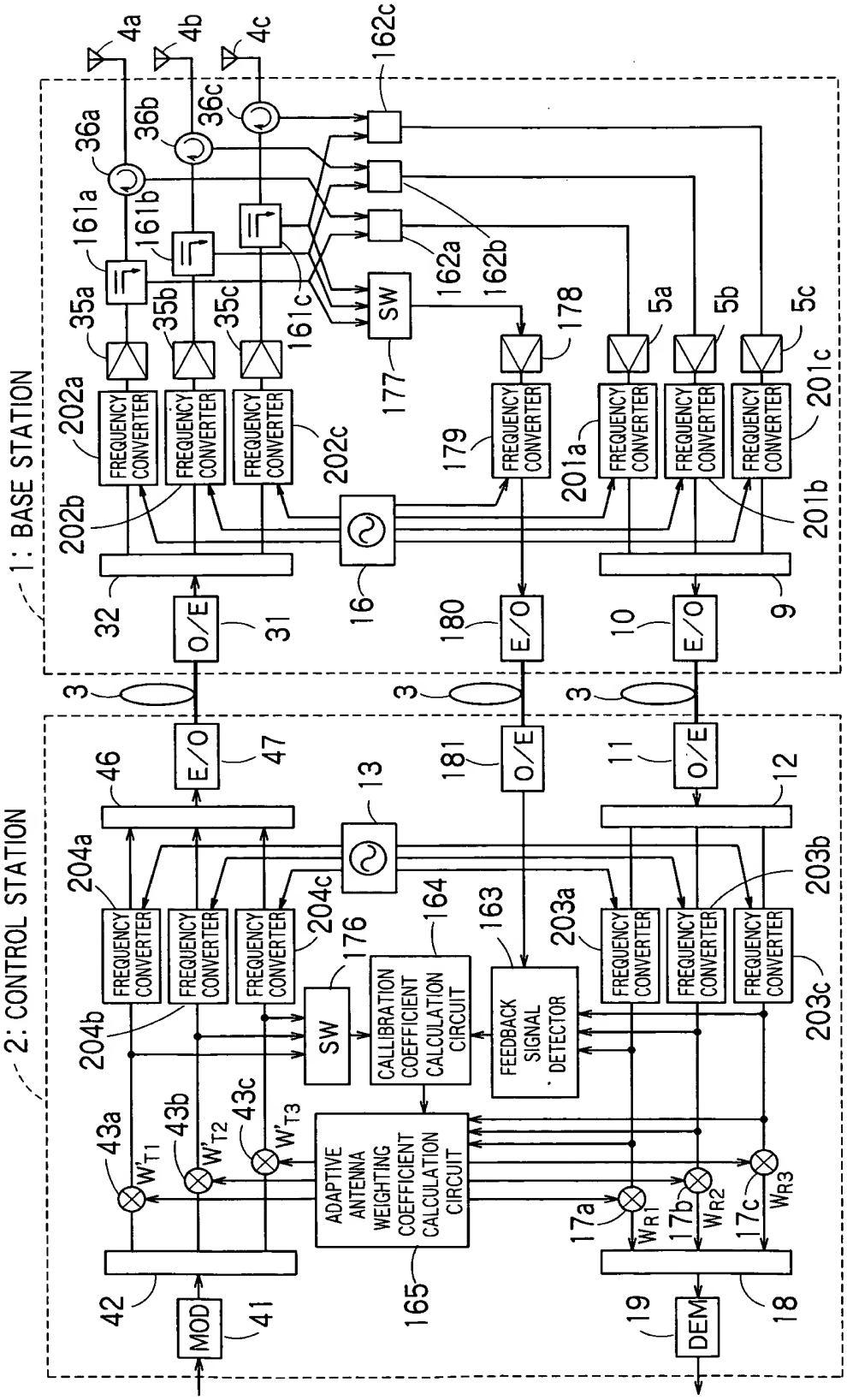
1: BASE STATION
2: CONTROL STATION
FREQUENCY CONVERTER
O/E
E/O
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
MOD
DEM

FIG. 41

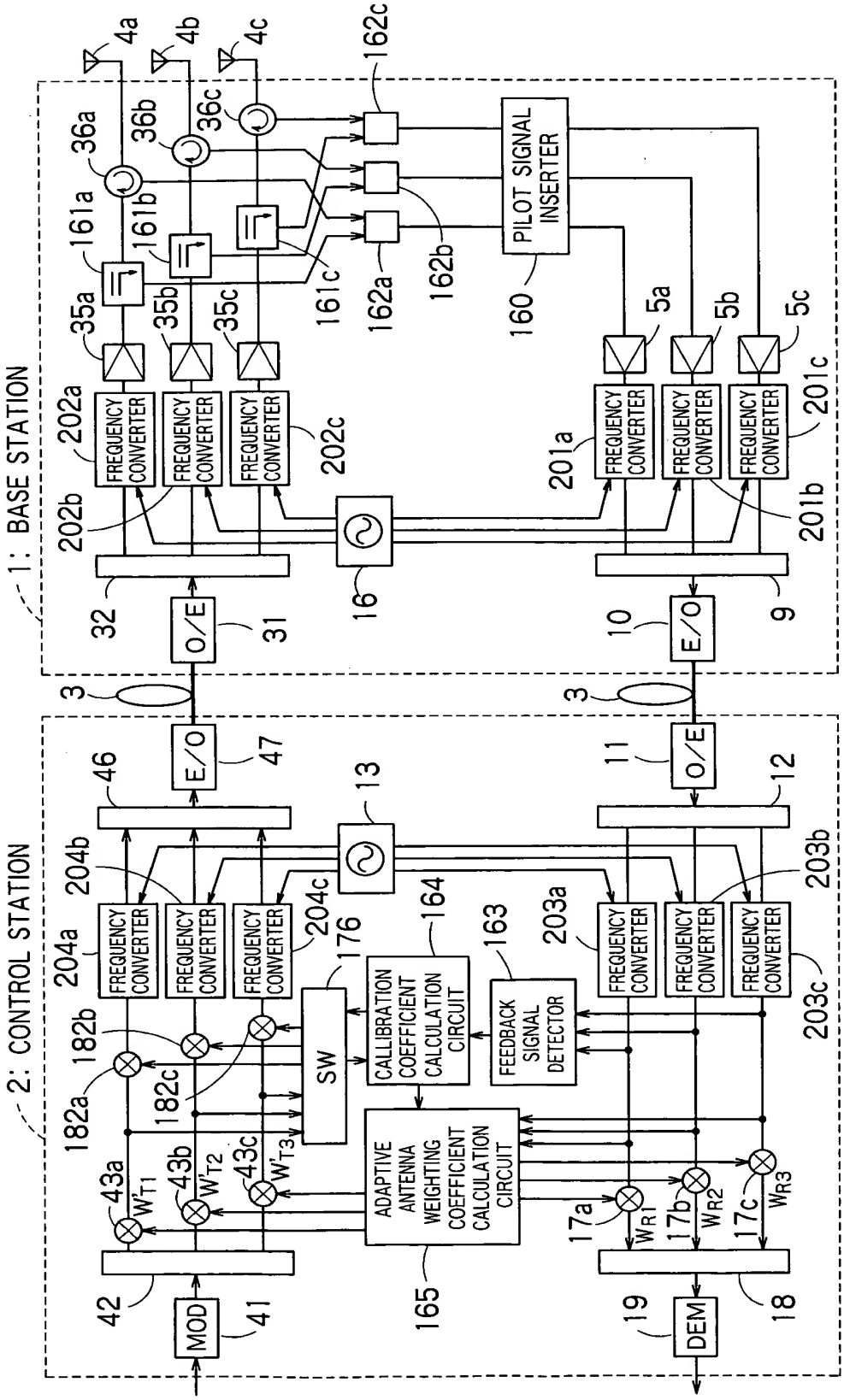
1: BASE STATION
2: CONTROL STATION
4a
4b
4c
36a
36b
36c
161a
161b
161c
162a
162b
162c
35a
35b
35c
PILOT SIGNAL INSERTER
160
5a
5b
5c
FREQUENCY CONVERTER
202a
202b
202c
201a
201b
201c
32
O/E
31
16
10
E/O
9
3
46
E/O
47
13
11
O/E
12
204a
204b
204c
203a
203b
203c
164
163
176
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
182a
182b
182c
43a
43b
43c
W'T1
W'T2
W'T3
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
165
17a
17b
17c
WR1
WR2
WR3
42
MOD
41
19
DEM
18

FIG. 42

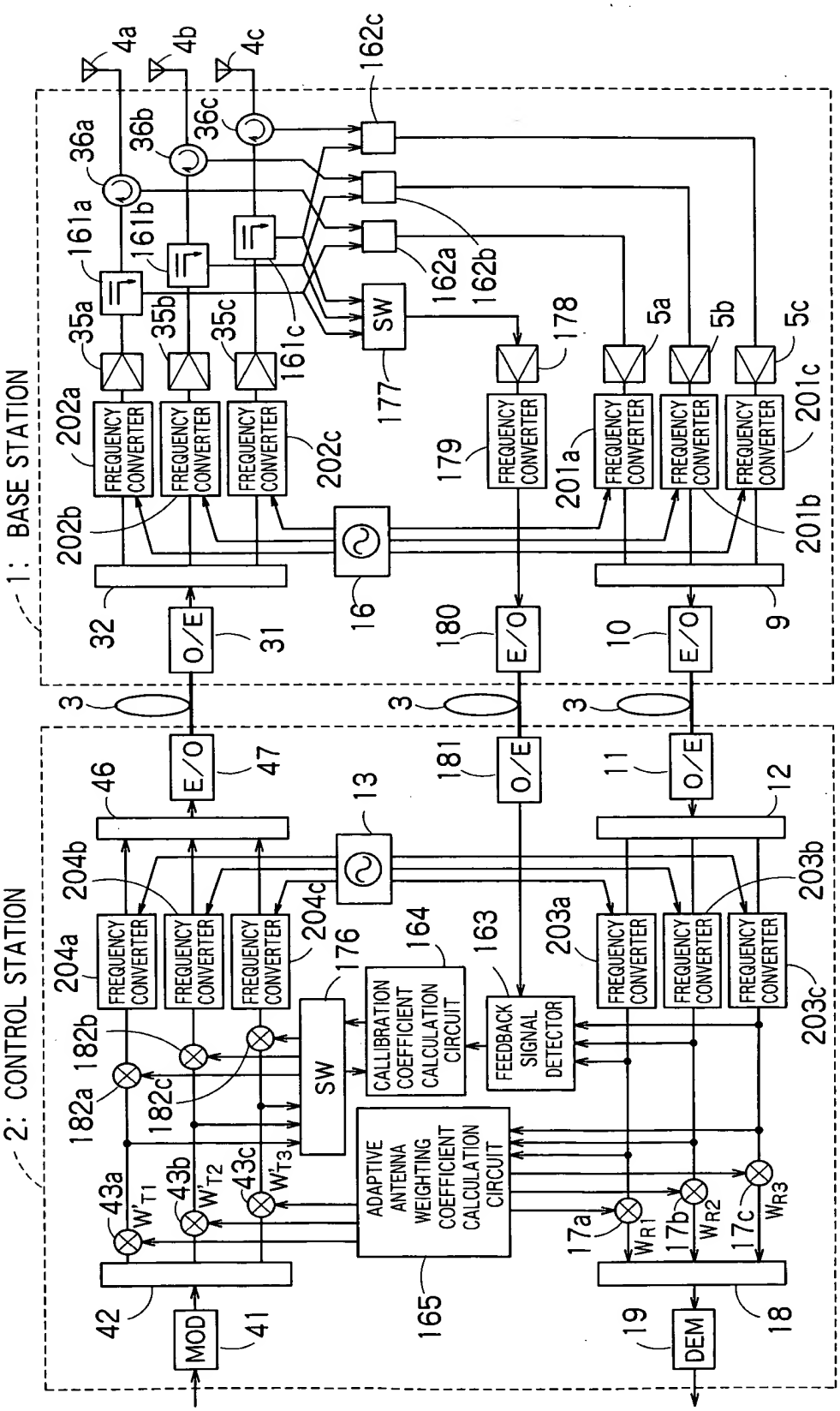
1: BASE STATION
2: CONTROL STATION
FREQUENCY CONVERTER
O/E
E/O
SW
CALLIBRATION COEFFICIENT CALCULATION CIRCUIT
FEEDBACK SIGNAL DETECTOR
ADAPTIVE ANTENNA WEIGHTING COEFFICIENT CALCULATION CIRCUIT
MOD
DEM

FIG. 43